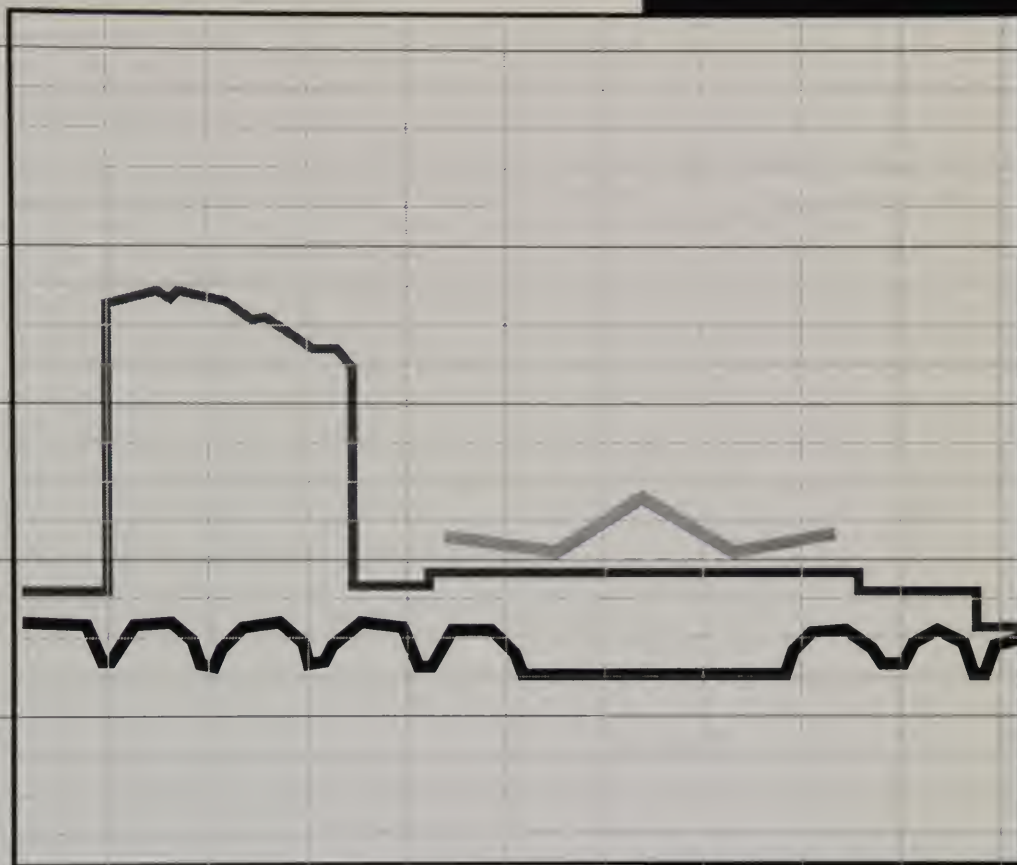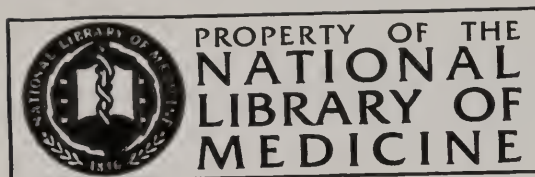# National Library of Medicine

Survey of Online Customers: Usage Patterns and Internet Readiness

National Institutes of Health
National Library of Medicine

National Library of Medicine
Survey of Online Customers:
Usage Patterns and Internet Readiness

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August 1996

TABLE OF CONTENTS

List of Tables

List of Figures

EXECUTIVE SUMMARY

Most National Library of Medicine (NLM) customers have access to the Internet, based on the results of this survey of NLM online database users, although the majority of these Internet-capable users do not currently access NLM databases via Internet.[i] The survey results provide a strong basis for the transition to Internet-based delivery of NLM online database services, including Internet Grateful Med[ii] and the NLM family of World Wide Web sites.[iii]

Internet access is uneven, however, according to the survey results, especially in rural areas and at hospitals. About 36 percent of rural users and almost half of users at hospitals do not have Internet access. Likewise, about half of users at rural libraries do not have Internet access. These results reinforce the need for continuing special outreach efforts directed at improving access for rural and hospital-based users and rural libraries.

Other survey highlights:

- Of the 75 percent of online users with Internet access, about three-quarters use Internet to access the World Wide Web. But only one-quarter use Internet to access NLM databases, suggesting a significant untapped potential for providing NLM databases via the Internet.

- Of the 25 percent of users without Internet access, almost three-fifths intend to upgrade to Internet within 12 months, which would reduce the total without Internet to about 11 percent of users.

- Most NLM online users already have computer platforms that can support Internet applications. Of the 81 percent of customers who use IBM-compatible computers, about 90 percent have 386 or better processors; three-quarters have a 486 or Pentium machine. For the 18 percent who use Macintosh computers, about 90 percent are using System 7 software.

- However, a small but significant number of customers may still have serious equipment limitations. Even with planned customer upgrades, about 12 percent of users are projected to still have 1.2 or 2.4 kilobaud modems, unacceptably slow for today's Internet applications. And 9 percent of IBM-compatible users are projected to still have a 286 or 386 machine, again too limited for today's Internet.

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[i] The survey results may actually understate the level of Internet access, since users of fixed-fee programs were excluded from the survey, and Internet connectivity is a requirement of fixed-fee programs.

[ii] Accessible at http://igm.nlm.nih.gov Users must register to obtain an access code and are charged nominal access fees depending on level of use.

[iii] Known as HyperDoc and accessible at http://www.nlm.nih.gov.

- The survey results indicate a high level of Windows use. For IBM-compatible users, all but about 13 percent have some version of Windows operating system. With upgrades, the percentage without Windows could fall to about 4 percent in 12 months, suggesting the use of Grateful Med for Windows as an interim solution for IBM-compatible customers still without Internet.

- Internet access is positively correlated with higher-end computer platforms. The faster the processor and modem and the larger the memory, the greater the likelihood that users have Internet access.

- Over four-fifths of NLM customers are health care providers, librarians, and scientists: health care providers account for 46 percent of users; librarians 20 percent; and scientists 19 percent. Educators totaled about 4 percent of users, and patients, consumers, students, and others about 11 percent collectively.

- The office is the primary search location for about 47 percent of respondents, and the home is the primary location for 32 percent. For primary search location, health care providers search 49 percent from home and 40 percent from the office, while scientists search 79 percent from the office and 18 percent from home. Librarians search 56 percent from a library, 25 percent from the office, 12 percent from a hospital, and 7 percent from home.

- Librarians are the most intensive users of NLM databases, with about three-fifths searching ten or more times a month

- Overall, NLM customers indicated a high level of satisfaction with NLM online services. Sixty percent were very satisfied, and 34 percent moderately satisfied. Only 3 percent were moderately dissatisfied, and one percent very dissatisfied.

The survey was mailed to a sample of 2,500 online users randomly selected from domestic billed users who searched NLM databases during the second quarter of 1995. The sampled population excluded users who could not be individually identified, such as users of fixed-fee programs and of NLM's reading room. The final response rate was 83 percent of eligible respondents.

NLM conducted the customer survey as part of its ongoing systems reinvention efforts. The survey was intended to: guide NLM's transition to Internet-based service delivery and specifically Internet Grateful Med; identify user groups that may require support of older versions of Grateful Med for a period of time; and plan special outreach initiatives that may be needed to assure a more rapid and equitable transition from the old to the new forms of service delivery.

INTRODUCTION

In February 1995, the National Library of Medicine (NLM) undertook to design and implement a survey of a representative sample of current online users. The primary purpose was to assess the availability of end-user technology capable of supporting an effective transition from Grateful Med to new forms of electronic information access and retrieval. Specifically, NLM wished to characterize users in terms of their:

- searching behaviors and level of satisfaction with NLM services;
- equipment platforms (hardware and software);
- use of telecommunications, particularly the Internet;
- equipment and telecommunications upgrades anticipated in the coming twelve months.

The design of the survey instrument and the selection and wording of survey questions reflected NLM management needs to

- predict the ability of NLM users to readily adopt a significantly different client-server search system (i.e., Internet Grateful Med) having high-end technology characteristics,
- quantify the relative proportion of users that would still require costly support of older versions of GM; and
- plan special outreach initiatives that may be needed to accomplish a more rapid transition from the old to the new.

The Survey Process

An NLM team prepared the initial draft survey instrument. After several revisions, the instrument was pilot tested with a random sample of thirty users in September 1995. The final version of the survey was fielded by Macro International Inc. to a random sample of 2,500 U.S. flat-rate and billed users who searched NLM databases during the second quarter of 1995. The population included only users who conducted enough search activity to generate a bill. Also, NLM's reading room and fixed-fee program users were excluded.

NLM extracted two user files: (1) 1,314 records of flat-rate program users; and (2) 17,754 records of regular billed users. Macro removed duplicates resulting in a population of 15,372 users, and then randomly drew 2,500 users. Questionnaires were mailed out to these 2,500 randomly selected users. Appendix B contains the cover letter; Appendix C the survey instrument.

The first mailing took place in October 1995, with subsequent mailings to non-respondents in November and December. Follow-up phone calls were placed in January 1996, with data collection terminated at the end of January.

Out of the 2,500 users sampled, 2,361 users were determined to be eligible NLM users. Of these 2,361 users, 1,955 completed a least one questionnaire for a response rate of 82.8%, as shown in Table 1. This is an exceptionally high response rate for a mail-out survey. Users who regularly search from a second location were requested to complete a second copy of the survey for that location. Ten respondents did so; thus, the 1,955 respondents returned at total of 1,965 surveys. Appendix D provides an overview of survey responses.

Table 1. Survey Response Rate

Original Random Sample	2,500
Could not be contacted by mail or phone	139
Eligible respondents	2,361
Completed one or more surveys	1,955
Response rate as percent of original sample	78.2%
Response rate as percent of eligible respondents	82.8%

Testing for Non-Response Bias

Data were available to make comparisons for purposes of determining non-response bias across NLM regions, across states, and across Census Bureau Metropolitan Statistical Area types (henceforward described as MSA Types[1]). Comparisons of the mail-out and response distributions for the NLM regions (see Appendix E) and states are shown in Tables 2 and 3, respectively. "Goodness-Of-Fit" chi-square values[2] were calculated. There were no statistically significant differences in response rates across states[3], including the District of Columbia and Puerto Rico, across known MSA Types[4], or across NLM regions[5]. The high response rate (83%) and the statistical results indicate that non-response bias is unlikely.

Table 2. NLM Regional Response Pattern

NLM Region	Percent of Mail Out	Percent of Responses
Greater Midwest	16.7%	16.9%
Middle Atlantic	16.4%	15.9%
Midcontinental	5.5%	5.7%
New England	8.3%	9.0%
Pacific NW	5.9%	6.2%
Pacific SW	15.5%	15.0%
SE/Atlantic	23.3%	22.8%
South Central	8.5%	8.5%
Total	*100.0%*	*100.0%*

[1] Respondent's ZIP code is either in or outside an MSA. If ZIP code is in an MSA, there are the following MSA Types: "inside a city center," "in city but outside center," "suburban" and "In MSA but outside city/suburban."
[2] Refer to Appendix A
[3] Chi-square=12.26,df=51,p>0.99
[4] Chi-square=5.71, df=4, p>0.22
[5] Chi-square=2.46, df=7, p>0.92

Table 3. State by State Response Pattern

	Mailed out		Response			Mailed out		Response			Mailed out		Response	
	#	%	#	%		#	%	#	%		#	%	#	%
AK	10	0.4%	8	0.4%	KY	24	1.0%	19	1.0%	OH	66	2.6%	47	2.4%
AL	34	1.4%	26	1.3%	LA	47	1.9%	42	2.1%	OK	21	0.8%	18	0.9%
AR	8	0.3%	5	0.3%	MA	94	3.8%	80	4.1%	OR	28	1.1%	25	1.3%
AZ	43	1.7%	37	1.9%	MD	148	5.9%	111	5.6%	PA	103	4.1%	79	4.0%
CA	316	12.7%	237	12.1%	ME	15	0.6%	14	0.7%	PR	6	0.2%	5	0.3%
CO	33	1.3%	29	1.5%	MI	74	3.0%	62	3.2%	RI	11	0.4%	9	0.5%
CT	63	2.5%	54	2.7%	MN	38	1.5%	29	1.5%	SC	16	0.6%	15	0.8%
DC	49	2.0%	36	1.8%	MO	45	1.8%	38	1.9%	SD	4	0.2%	4	0.2%
DE	13	0.5%	10	0.5%	MS	18	0.7%	13	0.7%	TN	38	1.5%	27	1.4%
FL	88	3.5%	69	3.5%	MT	24	1.0%	21	1.1%	TX	110	4.4%	82	4.2%
GA	53	2.1%	35	1.8%	NC	43	1.7%	38	1.9%	UT	13	0.5%	11	0.6%
HI	16	0.6%	12	0.6%	ND	12	0.5%	9	0.5%	VA	76	3.0%	60	3.1%
IA	28	1.1%	26	1.3%	NE	18	0.7%	15	0.8%	VT	12	0.5%	11	0.6%
ID	15	0.6%	11	0.6%	NH	12	0.5%	9	0.5%	WA	70	2.8%	56	2.8%
IL	93	3.7%	72	3.7%	NJ	95	3.8%	72	3.7%	WI	46	1.8%	42	2.1%
IN	31	1.2%	22	1.1%	NM	27	1.1%	20	1.0%	WV	14	0.6%	14	0.7%
KS	24	1.0%	17	0.9%	NV	11	0.4%	8	0.4%	WY	4	0.2%	2	0.1%
					NY	198	7.9%	152	7.7%					

THE NLM CUSTOMER BASE

NLM Online Users Profile

Health care providers, librarians (including other information services professionals), and scientists constitute the largest segment of the NLM database users responding to the survey (see Figure 1). These three groups account for 85 percent of all respondents. Educators, media (including journalists), students, members of the legal profession, and health care consumers (e.g., patients) make up the remaining 15 percent.

Who Are the NLM Online Users?

Health Care Provider	46%
Librarian	20%
Scientist	19%
Other/Missing	5%
Educator	4%
Media	2%
Health Care Consumer	2%
Student	1%
Legal	1%
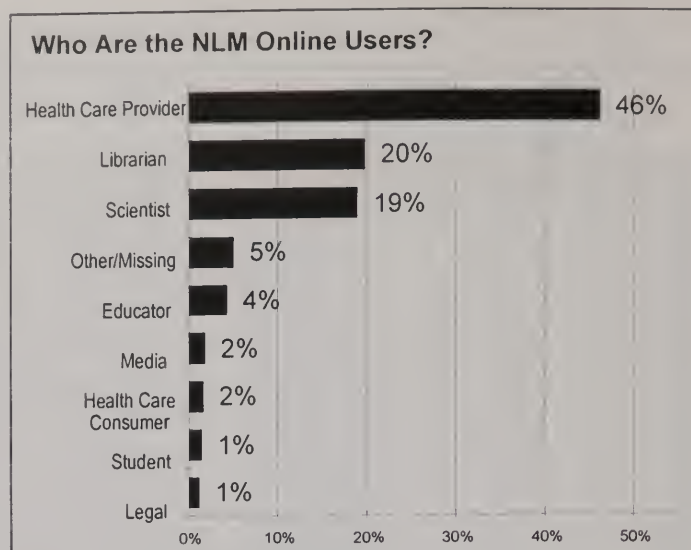
Figure 1. NLM Online Database Users

As a group, 19 percent of users search NLM databases less than once a month; 39 percent search one to three times each month; 23 percent search four to ten times each month; and 19 percent search more than ten times each month (see Figure 2). By far the one group of users who search most frequently are librarians and other information services professionals, 58 percent of whom report searching more than ten times each month. Scientists as a group are the second most frequent searchers of NLM databases, of whom 45 percent report searching four or more times each month. This compares to librarians (and other information services professionals), 77 percent of whom report searching four or more times each month. Health care providers generally do less frequent searches than the other groups.

User Group and Frequency of Use

- ▨ More than 10 times each month
- ☐ 4-10 times each month
- ■ 1-3 times each month
- ☐ Less than once a month

Total	19%	39%	23%	19%
Media	17%	49%	23%	11%
Legal	14%	50%	27%	9%
Librarian	10%	14%	19%	58%
Student	22%	52%	19%	7%
Educator	20%	45%	26%	8%
Scientist	14%	41%	33%	12%
Health Care Provider	25%	47%	20%	8%
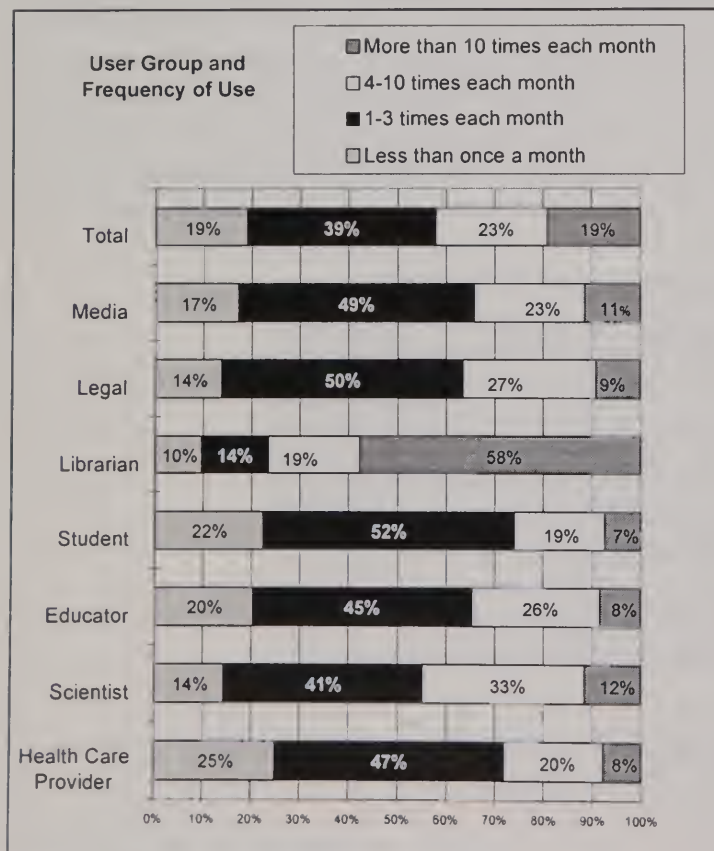
Figure 2. Users and Their Frequency of Use

Where Do NLM Users Do Their Searching?

Search Locations:
First and Second Most Frequent
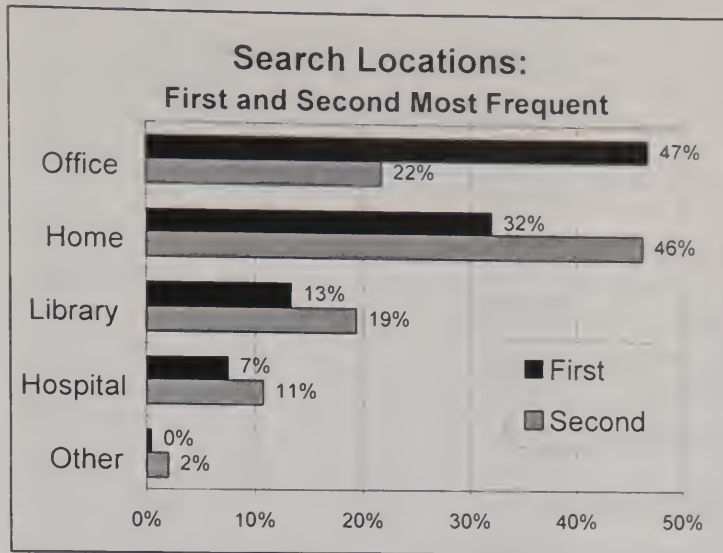
Figure 3. First & Second Most Frequent Search Locations

The office and the home are the most frequent locations for conducting NLM database searches (see Figure 3). The office is the primary search location for about 47 percent of respondents, and the home is the primary location for 32 percent. The pattern changes for the secondary search location, with 46 percent of the users reporting searching the NLM databases from home as their second most frequent search location.

Figure 4 represents the frequency of searching across the primary search locations. For example, looking at just the category search frequency "more than ten times each month," 47 percent occurs in libraries, and 35 percent occurs in offices. That is, in this category the most frequent searches are being done in libraries followed by offices. Considering the second most frequent category - four to ten times each month, searching is being done from offices followed by homes.

Most Frequent Search Location by Frequency of Searching

Figure 4. Primary Search Location and Frequency of Searching

Figure 5 displays the ten largest user groups and primary search locations from among all respondents. Health care providers searching from the home and the office form the two largest groups, followed by scientists in their offices, librarians in libraries and offices, and then health care providers in hospitals.

Figure 6 indicates the distribution of primary search locations across the user groups. This led to a separate analysis of just the health care providers, scientists, educators and librarians and their search
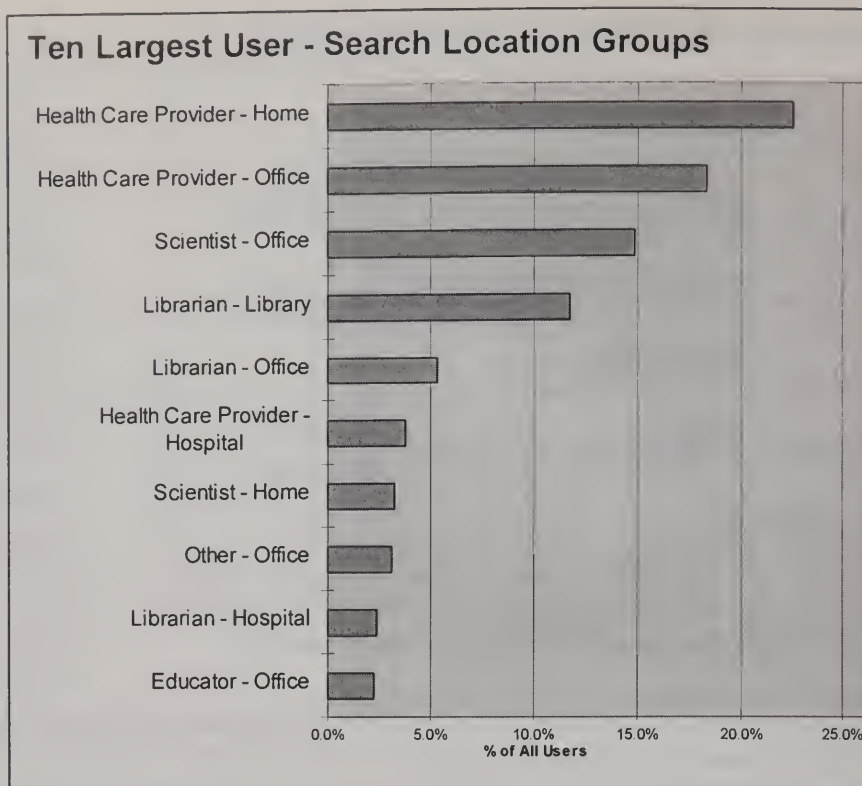
Figure 5. The Ten Largest User-Search Location Groups
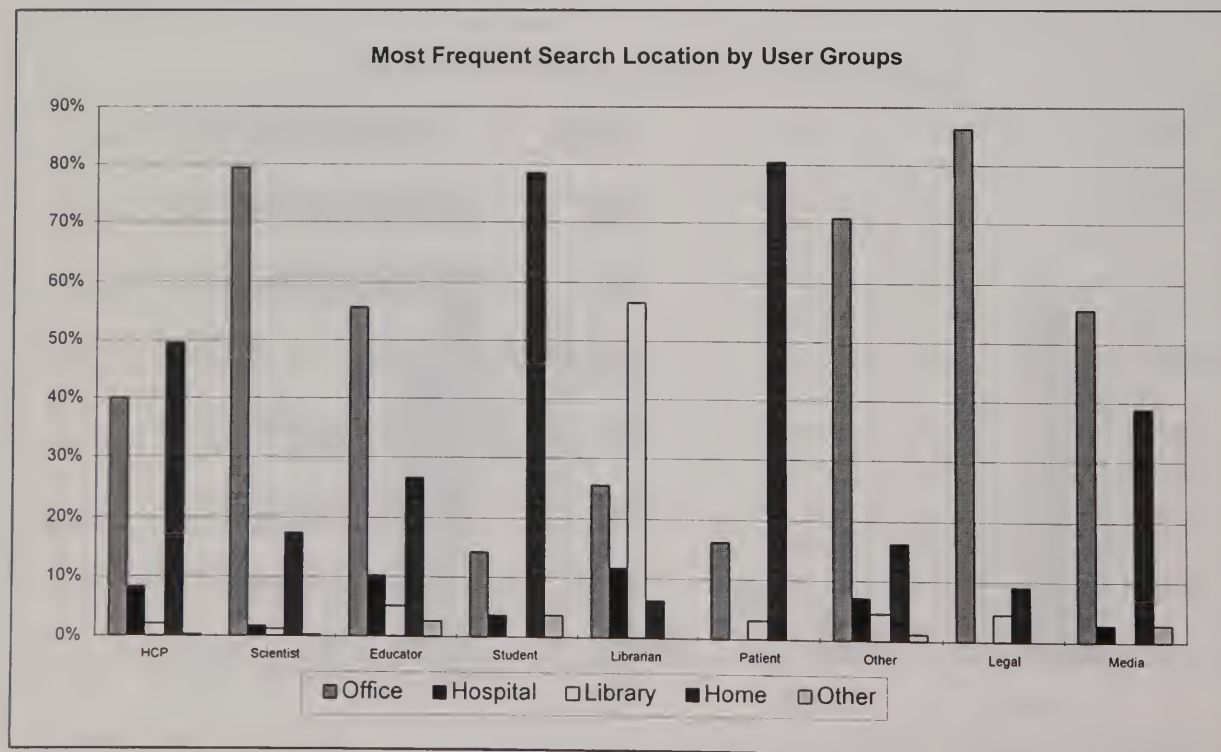
Figure 6. Location of Search by User Groupings

locations. There are significant differences among these four user groups in both the primary[6] and secondary[7] search locations. Health care providers primarily search from home, whereas, not surprisingly, librarians primarily do their NLM database searching from libraries. Scientists search primarily from their offices. Health care providers search secondarily from their offices and hospitals, while scientists use libraries and homes for their second most frequent search location.

Who are the most frequent users and their search locations? The analysis provided in Table 4 indicates that the librarian in a library is the largest single user-location grouping among the most frequent searchers of NLM

Table 4. Most Frequent User-Search Locations

4-10 Times Per Month		10 or More Times Per Month	
Scientist - Office	104	Librarian - Library	157
Health Care Provider - Office	87	Librarian - Office	43
Health Care Provider - Home	64	Health Care Provider - Office	35
Librarian - Library	32	Scientist - Office	33
Librarian - Office	26	Librarian - Hospital	25
Health Care Provider - Hospital	20	Health Care Provider - Home	13
Educator - Office	13	Health Care Provider - Hospital	9
Other - Office	12	Scientist - Home	8
Scientist - Home	11	Other - Office	7
Librarian - Hospital	11	Health Care Provider - Library	6

databases (those searching ten or more times each month)[8]. The numbers of respondents shown in Table 4 indicate the relative sizes of the various user-location-frequency of search groupings. Scientists searching from their offices four to ten times per month form the second largest grouping.

Geographic Distribution of Online Users

As was described in the section on "The Survey Process," MSA Type is a derived variable based on the Census Bureau's metropolitan statistical areas and a respondent's ZIP code. Each respondent was asked to supply the ZIP code of the location where he or she does the most NLM online database searching. A match was made against a Genesys database that

Figure 7. MSA Types of NLM Online Users

includes Census tracts and lists of ZIP codes that are associated with each tract. By this method most of the ZIP codes that were supplied are type cast as to the kind of census tract and whether the ZIP code is in a metropolitan statistical area (MSA). If the ZIP code is in the Genesys database, then the MSA Type can be determined. Figure 7 presents the distribution of NLM users across MSA Types.

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[6] Chi-square=977, df=9, p<.0001
[7] Chi-square=47, df=9, p<.0001
[8] Table 4 is based on 1,965 responses from the 1,955 respondents.

Respondents were mostly from cities, including inside city centers (46 percent), and outside city centers (13 percent). Twelve percent were outside MSAs, and primarily in rural areas of the country. There are of course, rural areas inside many MSAs, and these rural areas are considered to be outside the city and suburban areas, but not outside the MSAs. This rural category included about four percent of the respondents. About five percent of the survey respondents could not be classified due to unknown ZIP codes. Geographical breakdowns are discussed in the section on the survey process. These include both states and the NLM regions (see Tables 2 and 3).

Figure 8 indicates the primary search location for users in various MSA Types. In city centers the primary search location is the office. Hospital is used as a primary search location relatively more frequently in the areas outside of MSAs.
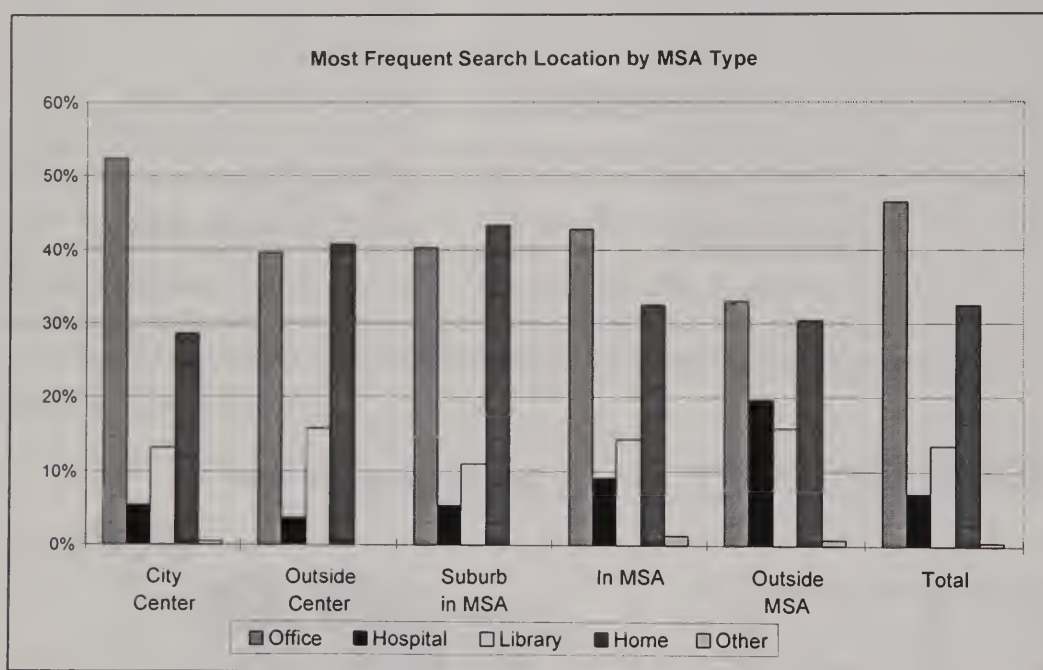
Figure 8. Primary Search Location by MSA Type

The largest user group - search location combination in each MSA Type is listed in Table 5. The health care provider is the largest user group in all Census Bureau defined MSA types (with known ZIP codes), with the search location being either office or home. The scientist searching from the office is the largest group in the unknown ZIP code areas. Many universities have special ZIP codes that are not included in the Gene-sys database, which may account for this anomaly.

Table 5. User-Search Location across MSA Types

Census Bureau MSA Type	User - Location of Use
MSA: inside city center	Health Care Provider - Office
MSA: outside city center in city	Health Care Provider - Home
MSA: suburban	Health Care Provider - Home
MSA: outside city/suburban	Health Care Provider - Office
Outside MSA	Health Care Provider - Home
Unknown Zip	Scientist - Office

The top 15 user-location-MSA-Type groupings were computed to better clarify the "who, what and where" of online users. Table 6 lists the 15 groupings in rank order by number of respondents. Health care providers, scientists, and librarians in city centers make up the largest segments.

Table 6. The Top 15 User-Location-MSA-Type Groupings

Census MSA Type	User	Search Location	Count
City center	Health Care Provider	Office	192
City center	Health Care Provider	Home	187
City center	Scientist	Office	145
City center	Librarian	Library	104
Suburban	Health Care Provider	Home	104
Outside city center in MSA	Health Care Provider	Home	67
Suburban	Health Care Provider	Office	60
Outside MSA	Health Care Provider	Home	56
Suburban	Scientist	Office	50
City center	Librarian	Office	45
Suburban	Librarian	Library	39
Outside MSA	Health Care Provider	Office	39
Outside city center in MSA	Librarian	Library	35
Outside city center in MSA	Health Care Provider	Office	32
Outside MSA	Librarian	Library	32

Figure 9 compares frequency of searching by rural versus urban users. The rural versus urban comparison indicates little difference in the frequency of searching NLM online databases. Indeed, there is no statistical difference between urban and rural users with respect to frequency of use.[9]
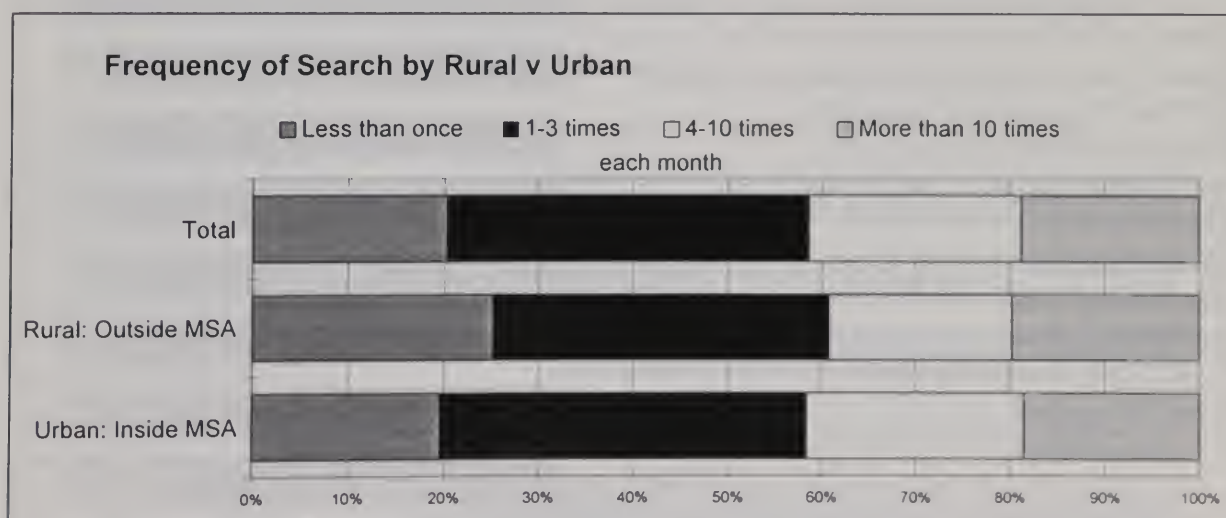
Figure 9. Urban v Rural Comparison of Frequency of Online Searching

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[9] Chi-square equals 5.16, df=3, p>0.16

Figure 10. Frequency of Use Across NLM Regions
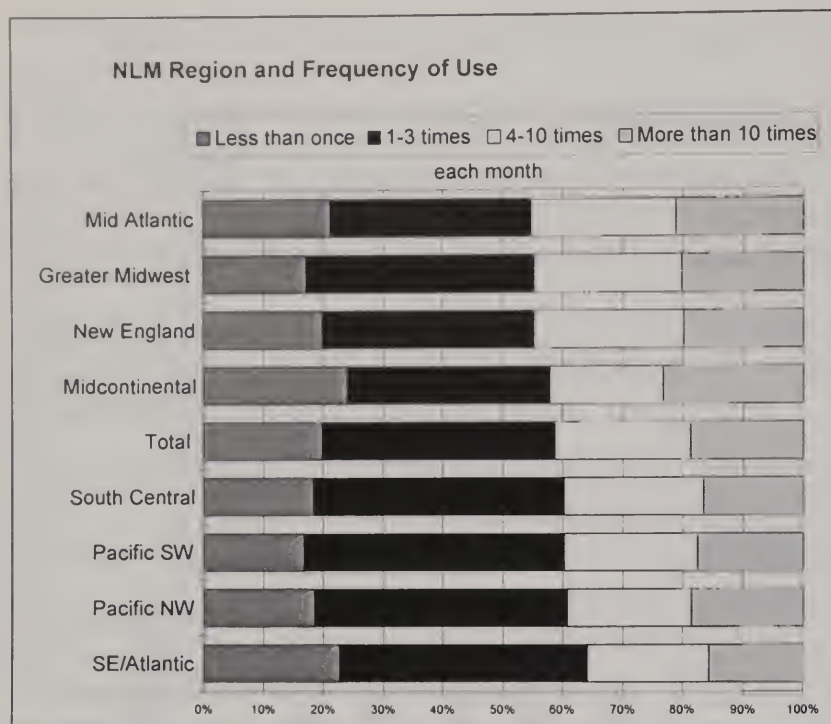
Figure 10 portrays the distribution of frequency of use across the NLM defined regions. The regions are listed in order of the combined percentages of four or more searches each month. The Mid Atlantic, Greater Midwest and New England regions top the list in this regard. However, there is no statistical difference across NLM regions with respect to frequency of use. [10]

Figure 11 compares the NLM regions in terms MSA Type comparisons of their urban versus rural make-up. The Pacific Southwest Region is the most urbanized of the NLM regions, based on respondent locations, while the Pacific Northwest is the most rural. The Greater Midwest and the Midcontinental regions are also more rural than other regions. While statistically significant, [11] there is no region that is specifically and predominately "rural."
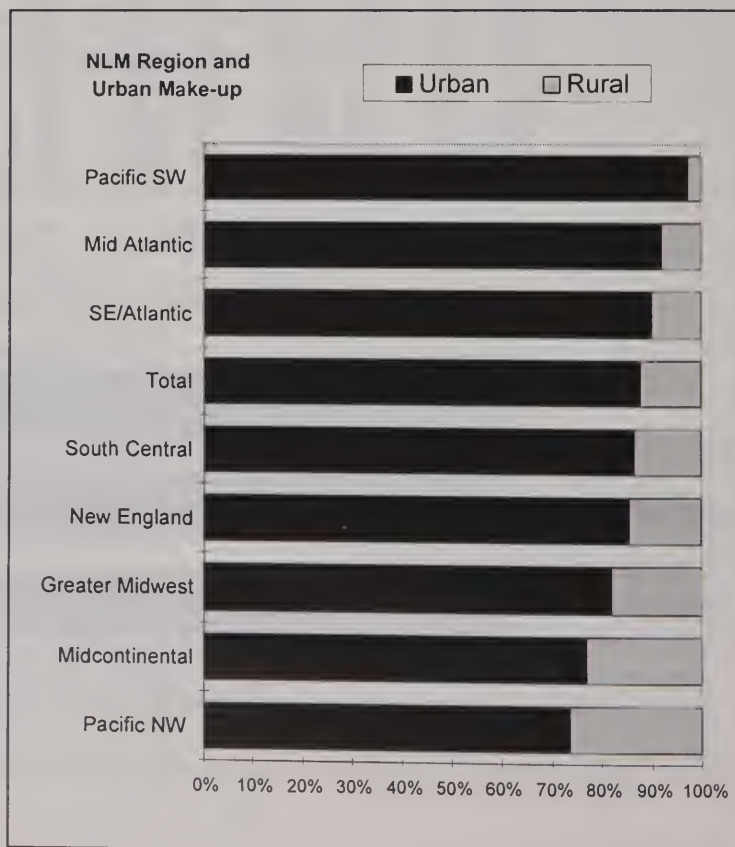
Figure 11. NLM Regions and Urban v Rural Make-up

[10] Chi-square=21.3, df=21, p>0.43
[11] Chi-square=114, df=7, p<0.0001

Grateful Med and Command Language Access
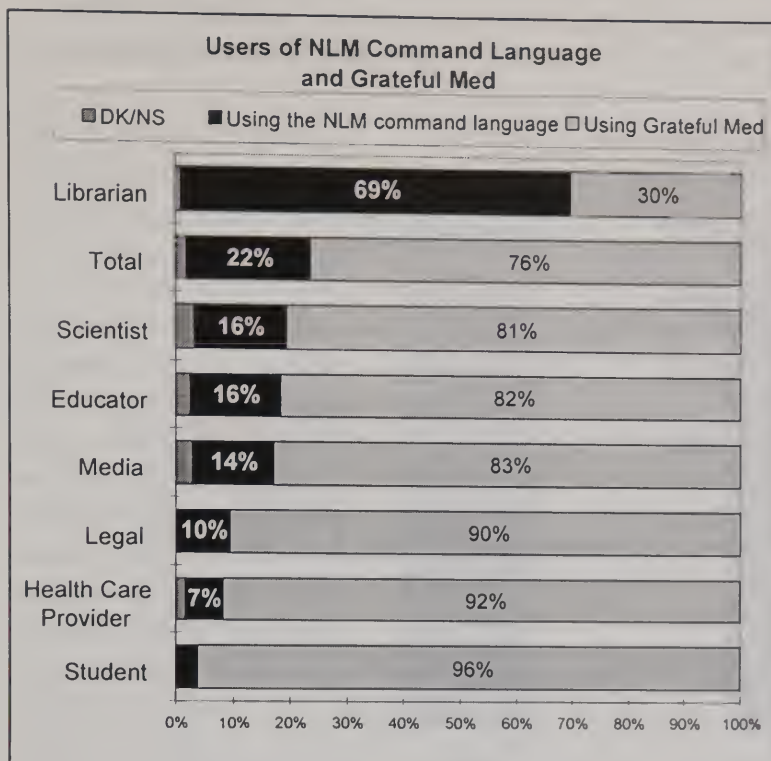
Figure 12. Users of Command Language and Grateful Med

At the time for the survey, users had two main methods for searching the NLM databases -- Grateful Med and the NLM command language. Figure 12 displays the survey results on search method. By far the one group using the command language the most includes librarians (and other information services professionals), with about 69 percent of this group using the NLM command language to search the online databases. The difference in search methods used between librarians and the other groups is statistically significant[12].

Among all other user groups, Grateful Med is the predominant access method, being favored by 81 to 96 percent of each of the other groups. Only about 7 percent of health care providers use the command language to search NLM online databases.

Figure 13 describes the distribution of use of Grateful Med versus command language across the primary search locations. Not surprisingly, users in libraries are the heaviest users of the command language for NLM online database searching. Users searching from home use command language the least.
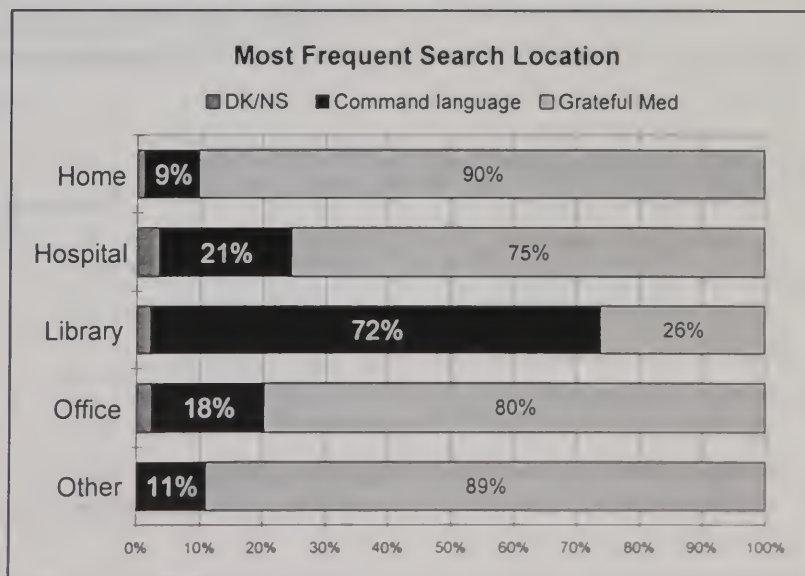
Figure 13. Primary Search Location and Access Mode

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[12] Chi-square=629, df=16, p<.0001

Figure 14 highlights a significant difference[13] in the methods used to search NLM databases between high frequency users (usually librarians and other information services professionals) and lower frequency users. High frequency users tend to use the command language to access the NLM databases. Lower frequency users rely heavily on Grateful Med to access NLM databases.
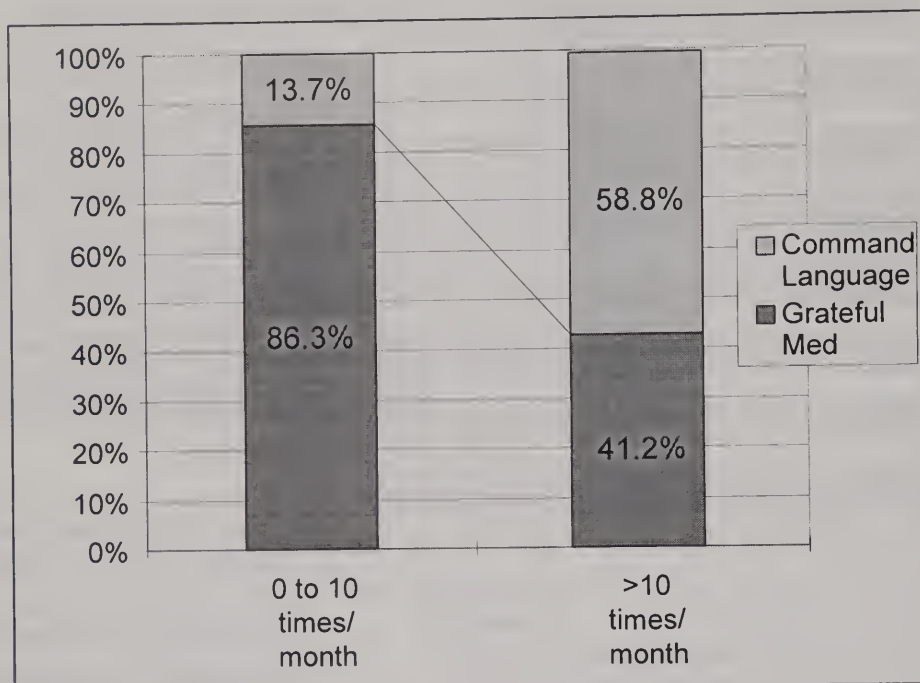
Figure 14. Search Methods Used by NLM Database Users

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[13] Chi-square=355, df=6, p<.0001

INTERNET ACCESS AND USE: CURRENT AND PROJECTED

Levels of Internet Access

Respondents were asked, "What type of access to the Internet do you have through the computer you most often use to search NLM's databases?" About 25 percent indicated that they believe they do not have Internet access. About four percent do not know or are not sure whether they have Internet access. The 1,931 respondents who answered the question provided 2,190 responses.

Internet Access

I dont have access to the Internet — 24.9%

Ethernet, Novell or other LAN — 21.5%

Dial-up with a modem — 27.6%

Prodigy,AOL, CompuServe — 35.3%

Dont know or not sure — 4.1%

0.0% 5.0% 10.0% 15.0% 20.0% 25.0% 30.0% 35.0% 40.0

Multiple Response: Percent of All Users with Mode of Access

Figure 15. Modes of Internet Access

This indicates that many users have several modes of Internet access on one computer. As shown in Figure 15, the largest single mode of access is via the commercial services such as America Online, Prodigy, and CompuServe, etc.

Figure 16. Internet Access and MSA Type

City center

Outside city center in city

Suburban

Outside city/suburban

Outside Metro Statistical Area

Unknown Geography

■ Prodigy, AOL, CompuServe, etc.

☐ Dial-up with a modem

☐ Ethernet, Novell or other LAN

■ I dont have access to the Internet

■ Dont know or not sure

0.0% 2.0% 4.0% 6.0% 8.0% 10.0% 12.0% 14.0% 16.0%
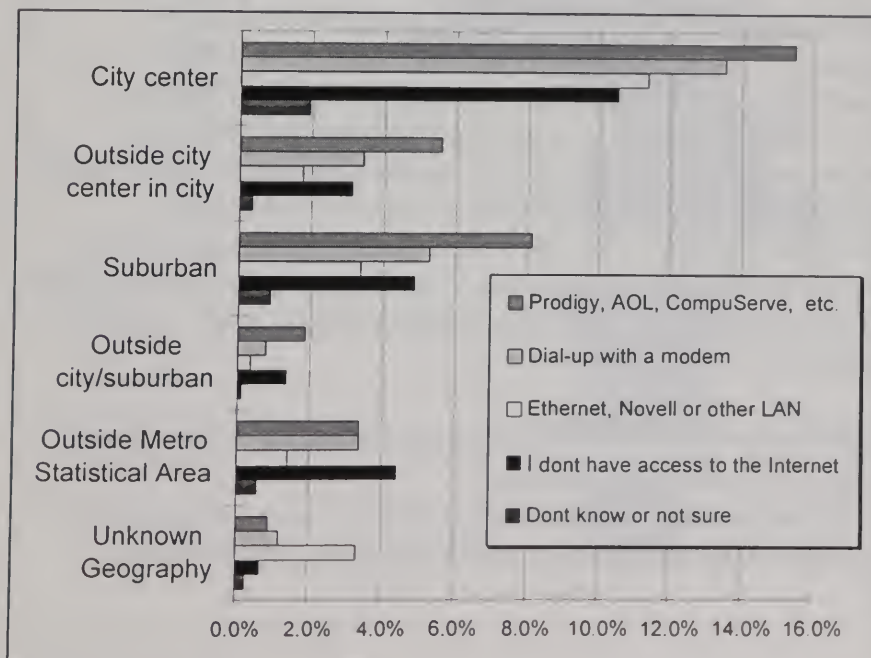
Figure 16 presents in overall percentages how the distribution of Internet access modalities varies across MSA Types. Since the largest number of respondents are from city centers, the largest number of all types of Internet access are in city centers as well. The largest number of users with no Internet access is also from city centers. But, as was confirmed with further analysis, those users outside MSAs have relatively less Internet access.

Figure 17 shows distribution of Internet access within each of the MSA Types. Figure 17 amplifies the difference seen in Figure 16, showing that the respondents outside of MSAs have disproportionately less Internet access.

Figure 17. Internet Access by MSA Type
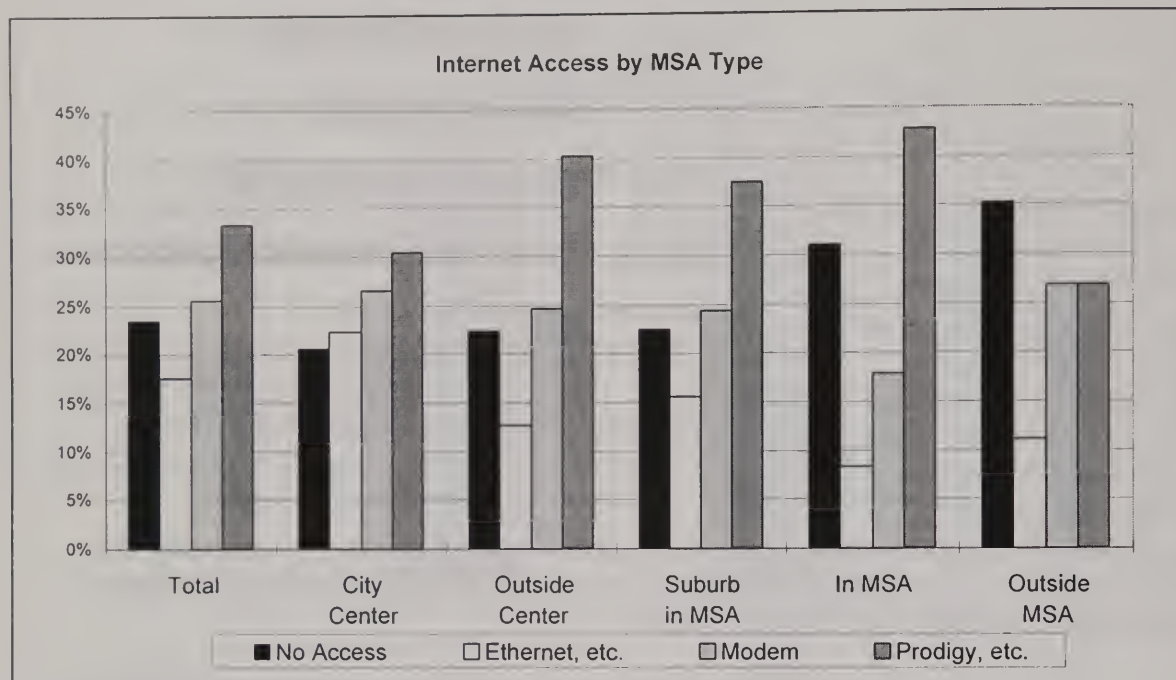
Figures 18 through 21 summarize the distribution of respondents with no Internet access across the key groups of variables listed. Figures 18 and 19 present the distribution of those respondents currently with no Internet access; Figures 20 and 21 present the projected distribution if respondents make their planned upgrades in Internet access. The Figures 18 through 21 represent intervals of estimation called 95 percent confidence intervals. It is estimated that there is a 95 percent probability that the true percentage lies within such intervals. When such intervals do not overlap in ranges, the groups they represent are said to be significantly different in value on that variable. The key variables examined in Figure 18 include: User group, first search location, MSA Type, urban v rural, NLM region of the country, frequency of search, computer support personnel, and computer type (IBM v Mac). One can readily see in Figure 18 that presently: [14]

- scientists as a group are more likely to have Internet access than librarians or health care providers, but not significantly different than educators;
- those who use hospitals as primary search locations are less likely to have Internet access;
- users who search from outside an MSA or in rural areas are less likely to have Internet access.

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[14] A statistical summary, which provides observed significance levels, is provided in a Table 7.
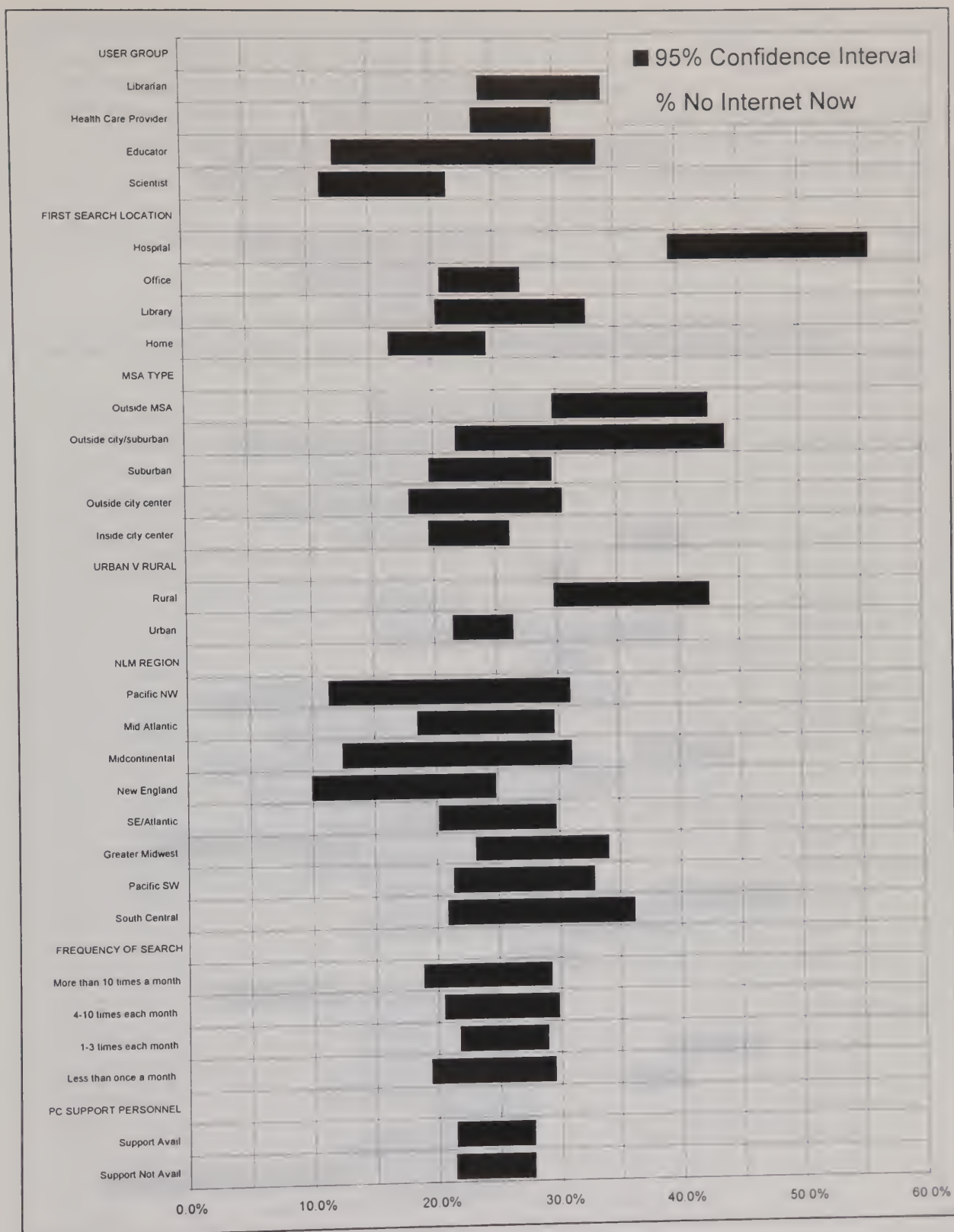
Figure 18. Percentage of Respondents with No Internet Access Now by Key Variables

NLM researchers sought to determine if the significant difference in access between urban and rural areas was specific to particular NLM regions. A logistic regression analysis[15] was carried out for this purpose. The results indicated that there was no unique contribution to predicting Internet access due to particular urban versus rural distinctions within the NLM regions. The only statistically significant geographical predictor of Internet access is the urban v rural distinction, which is independent of where in the country the respondent resides.

Figure 19 is a continuation of Figure 18, and specifically looks at the relationship of computer capabilities and Internet access. The confidence intervals indicate that:

- IBM-compatible computer users are less likely than Mac users to have Internet access;
- users with more up-to-date equipment and operating systems are more like to have Internet access.

Figure 19. Continued: Percentage of Respondents with No Internet Access Now by Key Variables

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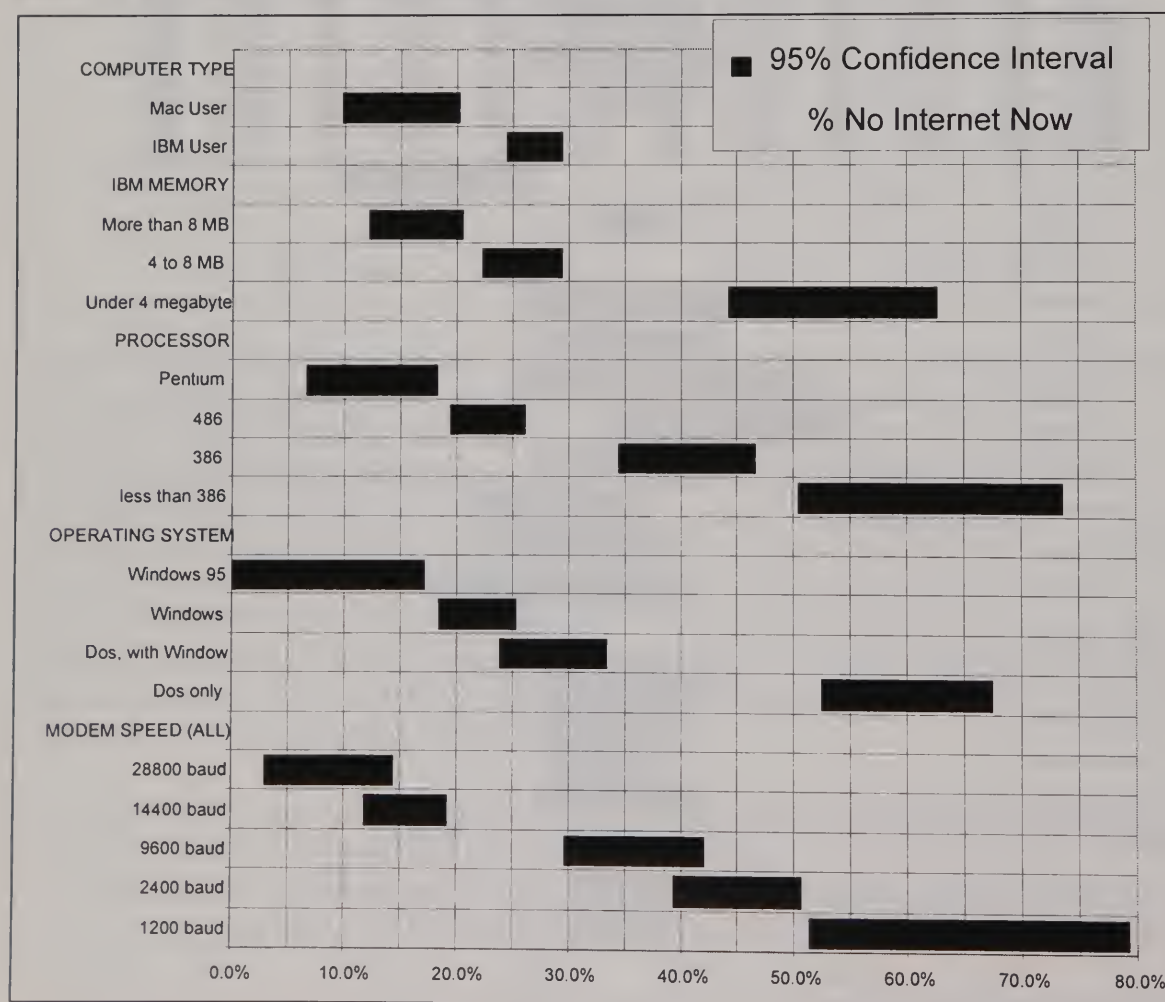
[15] Refer to Appendix A
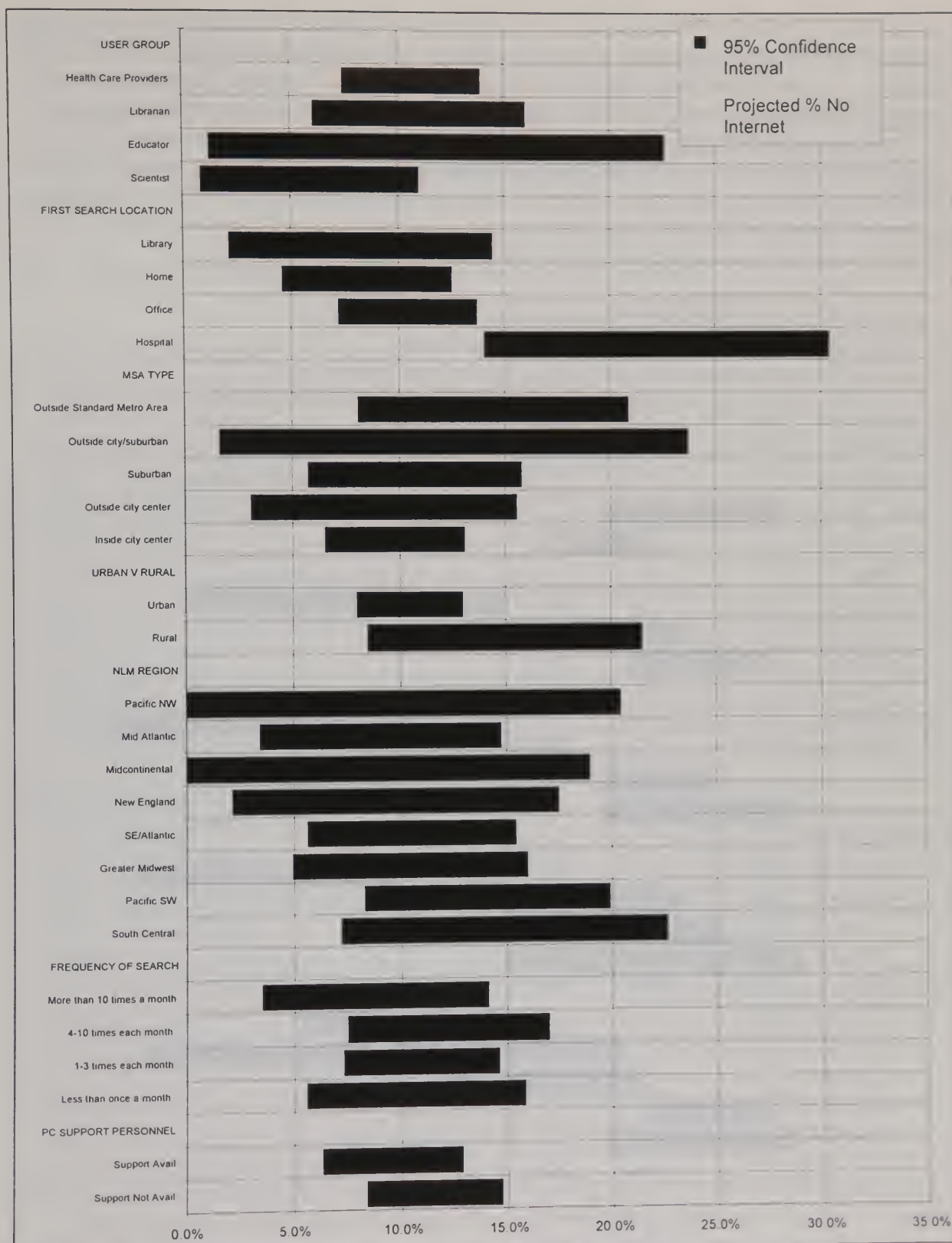
Figure 20. Percentage of Respondents with Projected No Internet Access by Key Variables

Figures 20 and 21 provide an analysis similar to Figures 18 and 19 except for the projected rather than current percentages of respondents without Internet access. Because of the uncertainty of respondent estimates for the future, projections for Internet access, while improving considerably, "muddle" the differences in Internet access that exist now. However, it does appear that hospitals will continue to have limited Internet access, and significantly less access than will be available from the home and office. Figure 21 indicates that Internet access will still be disproportionately higher for the users with the most up-to-date hardware and operating systems. The following users will have significantly[16] higher levels of Internet access:

- IBM-compatible users with more than 4 MB of memory;
- IBM-compatible users with access to Windows;
- IBM-compatible users with 486 or Pentium processors; and
- those with highest modem speeds (includes both IBM-compatible and Macintosh).
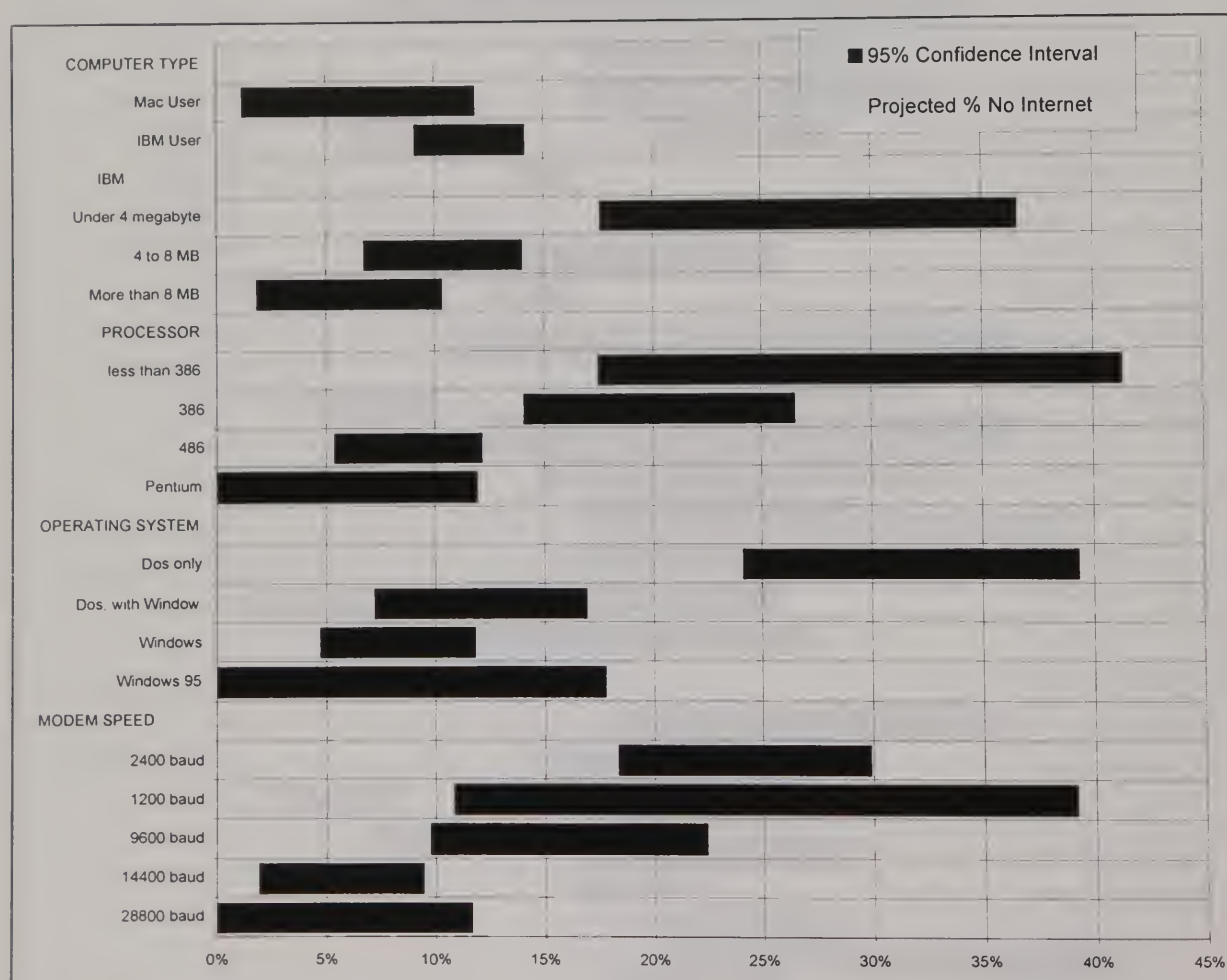
Figure 21. Continued: Percentage of Respondents with Projected No Internet Access by Key Variables

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[16] Refer to Table 7 for the observed significance levels.

Table 7 provides the observed significance levels[17] from statistical tests relating current Internet access with other selected variables. For example, there is no significant difference across NLM regions with respect to the proportion of respondents who do not have Internet access now. It is important to NLM researchers to determine whether the relationships between key variables and Internet access is retained when the analysis is statistically controlled for the following four groups: hospital primary search locations, health care providers (HCPs), librarians, and rural respondents.

Table 7. Observed Significance Levels for Internet Access by Selected Variables

		Controlling for:			
	All	**Hospital**	**HCPs**	**Librarians**	**Rural**
Currently No Internet by					
How do you most frequently search the NLM databases?	ns[18]	ns	ns	0.003	ns
IBM: How much memory...	0.000	ns	0.000	0.000	0.048
IBM: Type of processor...	0.000	ns	0.000	0.000	ns
IBM: Operating system of this computer...	0.000	ns	0.000	0.000	0.027
Mac: How much memory ...	0.042	ns	ns	ns	ns
Macintosh operating system...	0.000	ns	0.001	ns	ns
All: Highest speed of modem...	0.000	0.004	0.000	0.000	0.001
How often do you search the NLM databases?	ns	ns	ns	0.030	ns
Primary search location...	0.000	na[19]	0.000	0.000	0.025
MSA Type...	0.000	ns	0.014	0.010	na
Urban versus Rural...	0.000	ns	0.003	0.013	na
NLM Region...	ns	ns	ns	ns	na
Computer support personnel available?...	ns	ns	ns	0.017	ns
Type of computer do you most often use...	0.000	ns	0.006	0.036	ns
Projected No Internet by					
How do you most frequently search the NLM databases?	ns	ns	ns	0.001	0.038
IBM: How much memory...	0.000	ns	0.000	0.001	0.005
IBM: Type of processor...	0.000	ns	0.000	0.000	ns
IBM: Operating system of this computer...	0.000	ns	0.000	0.001	0.035
Mac: How much memory ...	ns	ns	0.042	ns	ns
Macintosh operating system...	ns	ns	ns	ns	ns
All: Highest speed of modem...	0.000	0.002	0.000	0.000	0.011
How often do you search the NLM databases?	ns	ns	ns	0.033	ns
Primary search location...	0.000	na	0.000	ns	ns
MSA Type...	ns	ns	ns	ns	na
Urban versus Rural...	ns	ns	ns	ns	na
NLM Region...	ns	ns	ns	ns	na
Computer support personnel available?...	ns	ns	ns	ns	ns
Type of computer do you most often use...	0.010	ns	ns	ns	ns

[17] Refer to Appendix A

[18] The note "ns" means "not significant." Refer to "statistical significance" in the glossary in Appendix A

[19] The note "na" "not applicable." Controlling for this variable reduces sample sizes too much or eliminates comparisons.

The analyses represented in Table 7 suggest several conclusions. Compared to other search locations, hospitals show consistently low Internet access independent of all key variables listed except modem speed.

Among librarians (and other information services professionals) and health care providers, Internet access for the most part follows the same patterns of relationships as for all users. An exception is among librarians and how they search the NLM databases. Those who use the command language are marginally less likely to have Internet access, and are less likely to have it in 12 months, than those who use Grateful Med.

Controlling for rural areas, the analysis of Table 7 indicates that the low Internet access in rural areas is independent of all the listed variables except modem speed, where faster modem speed means more Internet access. Table 8 emphasizes the finding in Figure 18 concerning low Internet access in rural areas. The distinction is true in all search locations and most apparent in library search locations.

Table 8. Rural-Search Locations and Percent Who *Lack* Internet Access

Primary Search Location	All MSA Types	Rural
Library	26%	49%
Home	20%	30%
Office	24%	29%
Hospital	48%	51%
All	25%	36%

The distribution of Internet access at primary search locations will be changing in the next twelve months as users upgrade and different locations grow differentially in Internet access. Figure 22 shows that home users will be advantaged with respect to Internet access, while hospitals will be relatively disadvantaged.
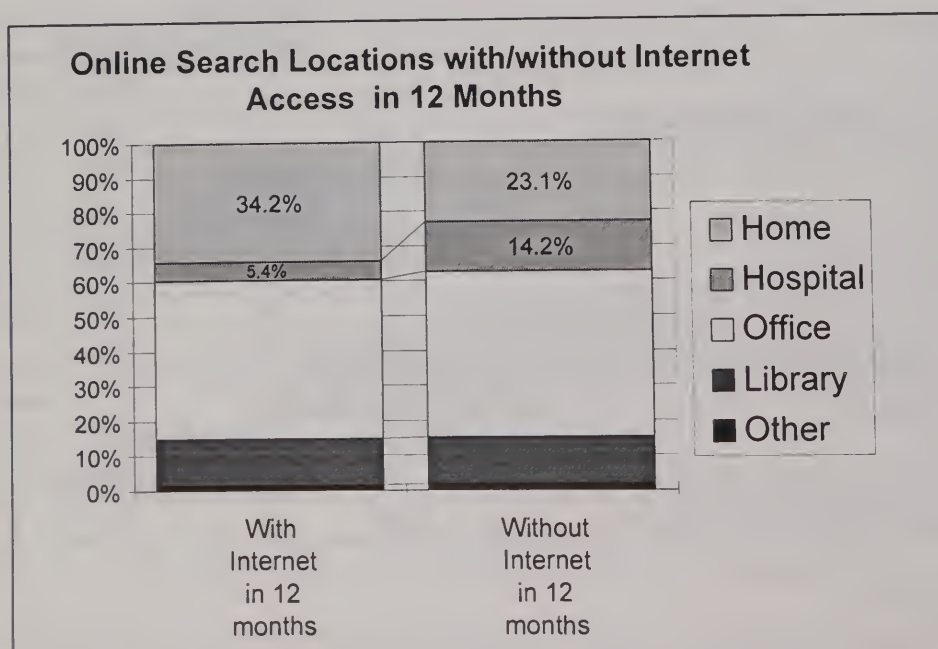
Figure 22. Distribution of NLM Searching by Internet Access

IBM Versus Macintosh Users and Internet Access

Availability of Windows and Internet Access
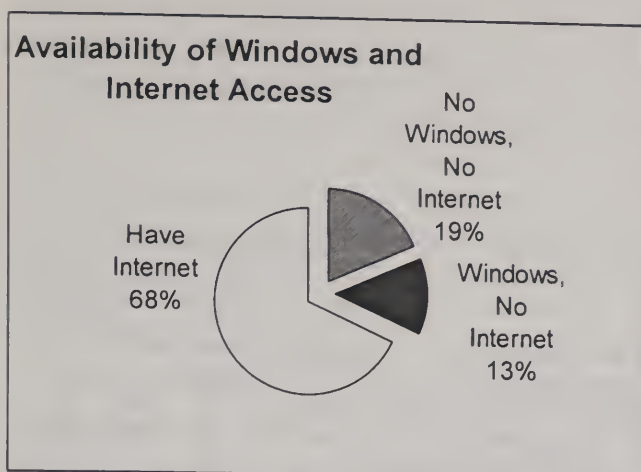
Figure 23. IBM Users: Windows and Internet Access

The significant difference between IBM-compatible and Macintosh computer users with respect to Internet access (Figures 19 and 21 and Table 7) warrants further analysis. If future NLM upgrades are oriented toward greater reliance on computer platforms running Windows or the equivalent with Internet access, then it is important to learn what will be required of present users to make that transition. Of the IBM-compatible users (N= 1,568 for this question), 19 percent have neither Windows nor Internet access, and 13 percent have Windows available, but no Internet (see Figure 23). Sixty-eight percent have both Windows and Internet access. This is in marked contrast to the Macintosh users (N=353), 80 percent of whom presently have Internet access (see Figure 24).

Several key variables were examined to determine their impact on Internet access. For IBM-compatible users, there is no significant relationship[20] between Windows/Internet Access and

- type of user,
- frequency of use, or
- availability of support personnel.

For Macintosh users there is no relationship[21] between Internet access and

- type of user, or
- frequency of use.

Macintosh users are more likely[22] to have Internet access if computer support personnel are available.

MacIntosh Users & Internet Access
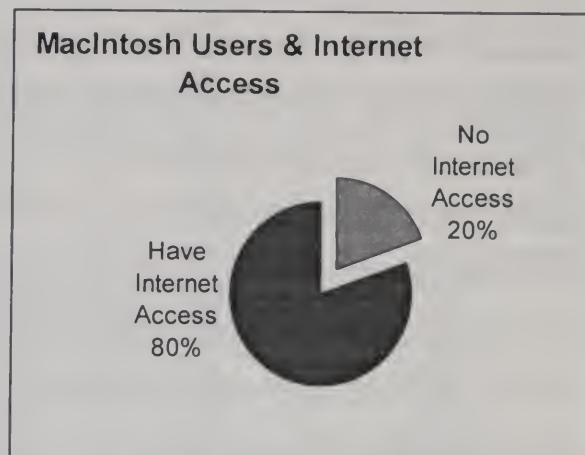
Figure 24. Macintosh Users and Internet Access

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[20] All observed significance levels >0.05

[21] All observed significance levels >0.05

[22] Observed significance level <0.01

Figure 25 summarizes much of the previous Internet discussion in a flow chart format. The chart indicates the percentages of those who do not presently have Internet access but intend to upgrade in the next twelve months. Also, there is a profile of those who have Internet access and use it to search NLM databases, those who have Internet access but do not use it, and those users who do not have Internet access. Refer to Table 7 for the observed significance levels for the Internet and no-Internet comparisons across these variables.

Profile	With Internet Access	User	Non-user	No Internet Access
Health Care Providers	45%	31%	50%	49%
Scientists	21%	35%	17%	12%
Educators	5%	3%	5%	4%
Librarians	19%	23%	17%	23%
Students	2%	1%	2%	1%
Others	8%	7%	9%	11%
Urban	89%	90%	89%	82%
Rural	11%	10%	11%	18%
IBM-compatibles				
Pentium	22%	21%	22%	9%
486	59%	61%	60%	48%
386	14%	14%	14%	26%
<386	2%	2%	2%	11%
<4 MB	5%	6%	5%	15%
4-8 MB	49%	46%	51%	47%
>8 MB	41%	45%	40%	22%
Windows	55%	61%	55%	42%
DOS only	6%	6%	6%	25%
All modems:				
28,800 baud	21%	24%	21%	6%
14,400 baud	48%	44%	50%	25%
9,600 baud	13%	11%	13%	21%
2,400 baud	13%	14%	13%	31%
1,200 baud	1%	1%	1%	7%

Figure 25. Flow Chart of Internet Access and Use

NLM users were asked what kind of Internet access they have now and what kinds of Internet access upgrades, if any, they were expecting in the next twelve months. About 25 percent of respondents do not have Internet access now. As can be seen in the Table 9, about eleven percent of respondents indicate that they do not have Internet access now and that they expect no upgrade. A more pessimistic estimate results from adding the "don't know/not sure" respondents to the "no upgrade expected respondents" for a total of about 19 percent[23], who may not have Internet access in twelve months. This is a worst case estimate that assumes that all respondents who do not know or are not sure if they ha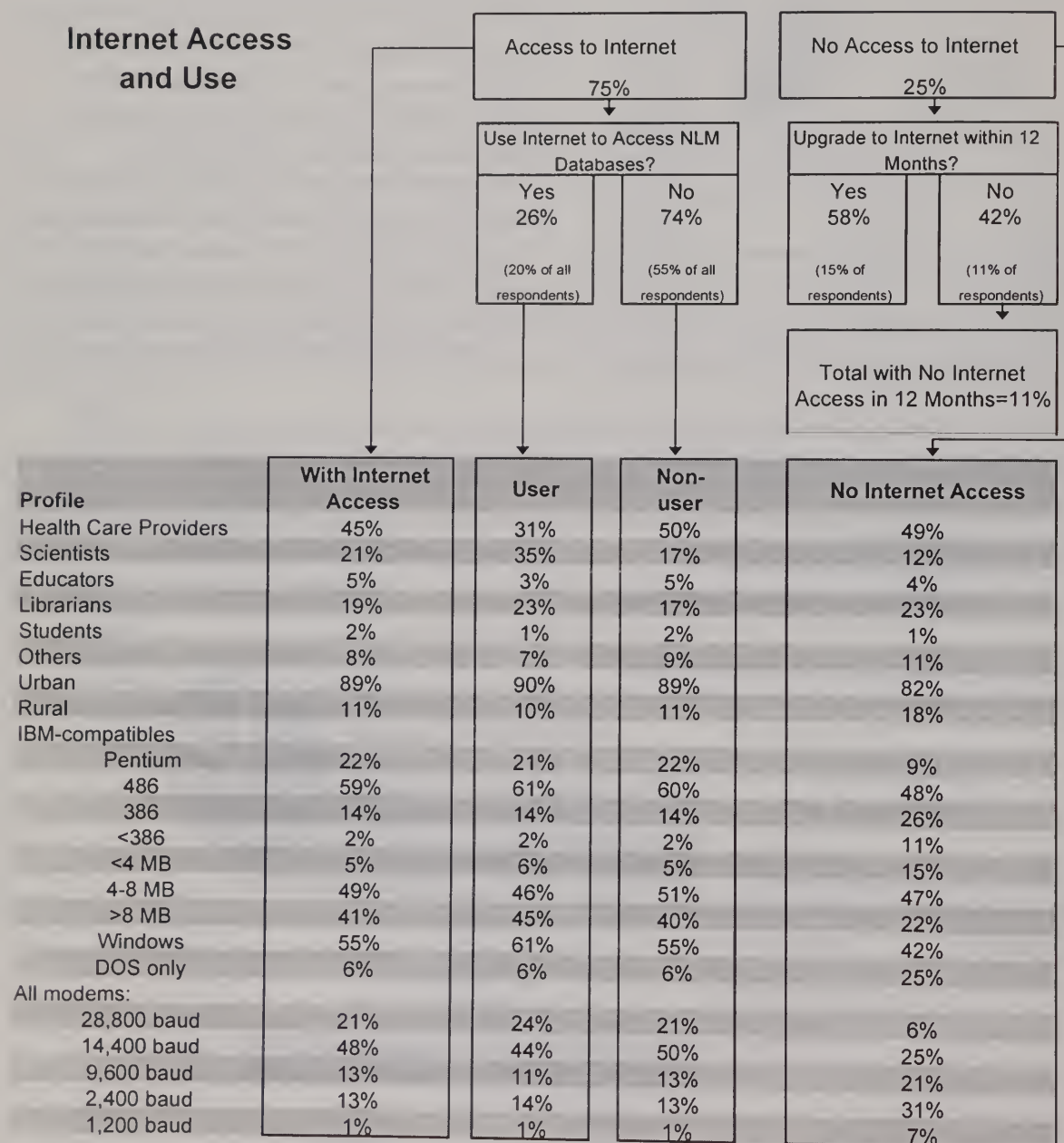ve Internet now or expect to upgrade in twelve months will not have Internet. Estimating within a 95 percent confidence interval, at best 8.5 to 12.9 percent, and at worst 17 to 21.4 percent of NLM users will *not* have Internet access in twelve months.

Table 9. Internet Access Now and in 12 Months

| Presently | In 12 Months | | | | |
	No Upgrade expected	Ethernet, Novell, etc.	Dial-up with a modem	Prodigy, AOL, CompuServe	Don't know or not sure
No access to Internet	10.7%	2.0%	2.4%	4.1%	6.2%
Ethernet, Novell, etc.	14.1%	2.5%	0.5%	0.4%	4.6%
Dial-up with a modem	18.1%	3.9%	1.6%	1.1%	3.9%
Prodigy, AOL, CompuServe, etc.	21.6%	2.4%	2.3%	3.0%	7.4%
Don't know or not sure	1.4%	0.0%	0.4%	0.2%	2.3%

(Note: Totals in Table 9 add up to more than 100% due to multiple responses)

Respondents, who do not use the Internet to access NLM's online databases, were given the opportunity to specify why. For the 774 users who responded, Table 10 lists the reasons stated for not using the Internet.

Table 10. Reasons for Not Using Internet

Reason	Percent of Respondents Who Indicated this Reason
Prefer Grateful Med /direct access	49%
Can't figure out Internet	17%
Other reason	9%
Did not know one could	7%
Cost	4%
Just have not tried it	4%
Just got/will get Internet soon	3%
Modem too slow	3%
Reliability	2%
Don't know	1%
No need/No advantage	1%

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[23]   Adding 10.7% + 6.2% + 2.3% = 19.2%

Access to The World Wide Web and Other Internet Features

Of the respondents who indicated that they had access to the Internet via any type of local area network (LAN), a modem dial-up or a commercial gateway such as Prodigy, America Online, or CompuServe, questions were asked about what Internet services they had available and their access to the World Wide Web (WWW). Of the 1,339 respondents in this category, eight percent indicated that they either did not have access to WWW or they did not know. Table 11 indicates by multiple response frequencies the WWW access based on the type of Internet access the respondents have. Those who have access via a LAN or a modem dial-up predominantly use a Web browser, while those using a commercial gateway may be using whatever their provider has available.

Table 11. WWW Access and Internet Access Mode

Access to World Wide Web	Type of Internet Access			
	Local Area Network	Modem Dial-up	Commercial Gateway	All
No WWW access	3%	4%	3%	3%
Web browser	86%	75%	41%	59%
Dial-up with modem	23%	62%	18%	29%
Prodigy, AOL, etc.	21%	35%	87%	50%
Don't know or not sure	7%	3%	4%	5%

Percents and totals based on 1,339 respondents. Totals add to more than 100% due to multiple responses.

Out of all the services provided via the Internet, e-mail is used the most across all access types. Table 12 indicates that well over 90 percent of those who access the Internet via LAN and modem dial-up have used e-mail in the last year, and over 80 percent have used WWW. Those who access the Internet via the commercial gateways use e-mail and WWW proportionately less than the other two access modalities.

Table 12. Internet Services Used and Internet Access

Internet Service Actually Used in Last Year	Type of Internet Access			
	Local Area Network	Modem Dial-up	Commercial Gateway	All
E-mail	91%	94%	77%	85%
FTP	57%	53%	29%	41%
Telnet	56%	53%	20%	38%
Gopher	65%	63%	44%	53%
WWW	85%	84%	73%	77%
Other	4%	6%	5%	5%

Percents and totals based on 1,285 respondents. Totals add to more than 100% due to multiple responses.

Of those respondents who have Internet access, those searching NLM databases primarily from libraries and offices have used e-mail and WWW the most. Table 13 shows the distribution of Internet services used across the primary search locations. For example, 79 percent of those who search NLM databases primarily from their offices have used the WWW, and 87 percent have used Internet e-mail in the last year.

Table 13. Internet Services Used and Search Location

Internet Service Actually Used in Last Year	Primary Search Location				
	Office	Hospital	Library	Home	All
E-mail	87%	81%	90%	80%	85%
FTP	47%	37%	42%	32%	41%
Telnet	42%	32%	63%	23%	38%
Gopher	56%	38%	65%	45%	52%
WWW	79%	68%	80%	74%	77%
Other	5%	5%	4%	5%	5%

Percents and totals based on 1,266 respondents. Totals add to more than 100% due to multiple responses.

Of those who have Internet access, scientists and librarians have used e-mail and WWW the most. Table 14 shows the distribution across the major user groups. Among scientists, 81 percent have used the WWW, and 93 percent have used Internet e-mail in the last year; which is nearly the same proportions for librarians (and other information services professionals).

Table 14. Internet Services Used and Major User Groups

Internet Service Actually Used in Last Year	Major User Groups				
	Health Care Providers	Scientists	Librarians	Others	All
E-mail	79%	93%	92%	80%	85%
FTP	32%	54%	46%	40%	41%
Telnet	23%	50%	63%	33%	38%
Gopher	43%	62%	64%	51%	52%
WWW	75%	81%	80%	74%	77%
Other	6%	3%	5%	6%	5%

Percents and totals based on 1,297 respondents. Totals add to more than 100% due to multiple responses.

Of all the services listed, Telnet and FTP (File Transfer Protocol) are either the least used, or respondents are the least aware of having used them in the last year. Users may not be aware that their Web browsers may Telnet to a site, or download files via FTP.

End-User Computer Equipment: Current and Projected

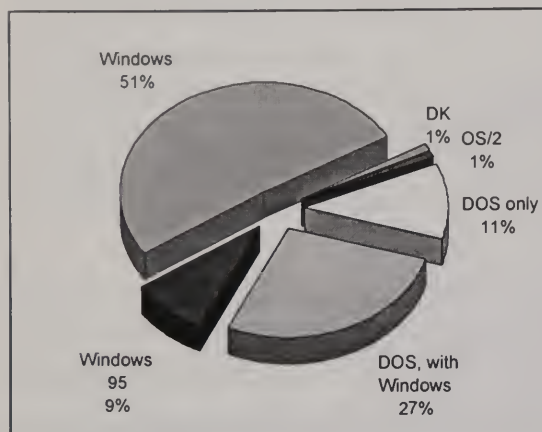### *Users with IBM-Compatibles: Ready for Windows?*

Figure 26. Windows-Ready Computers

Users with IBM-compatible computers were examined as a group with regard to operating system (see Figure 26). It appears that all but about 13 percent are Windows capable. Twenty-seven percent have Windows available on their computers, although they use DOS. About 60 percent have Windows 3.x or Windows 95 in use on their computers. Eleven percent have only DOS on their IBM-compatible computers.

Figure 27 represents the distribution of IBM-compatible processors across MSA Types. The rural group of users defined as those being outside an MSA appears low in the availability of Pentium computers and higher than average in 386s. The apparent differences, however, are not statistically significant[24].
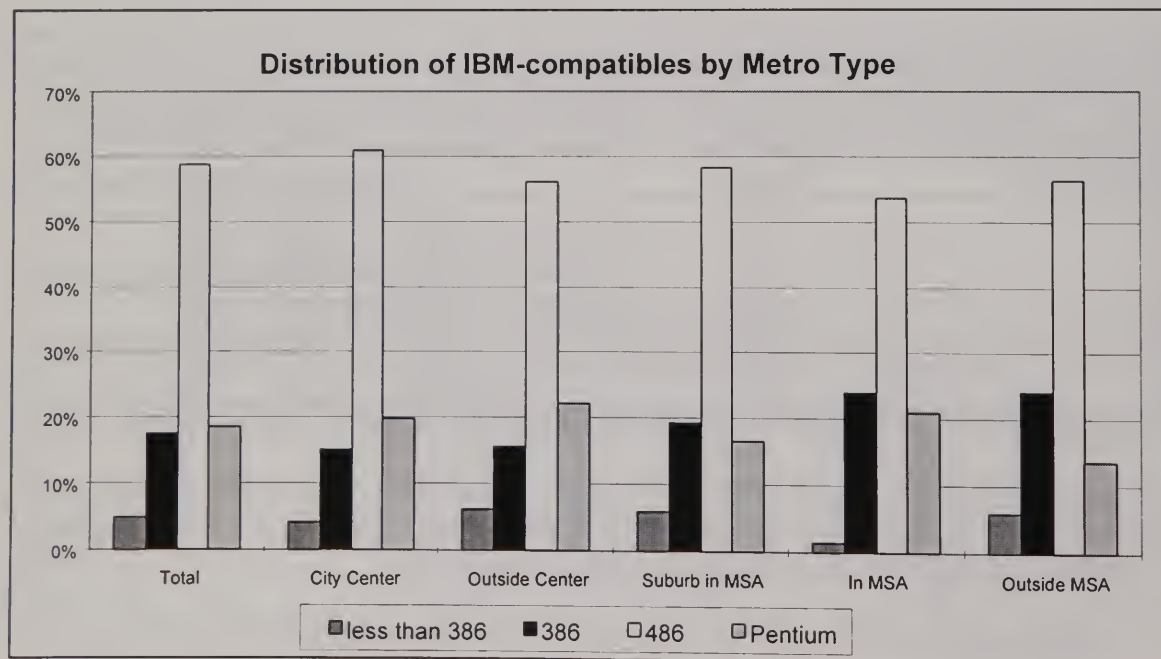

Figure 27. IBM-compatible Computers across MSA Types

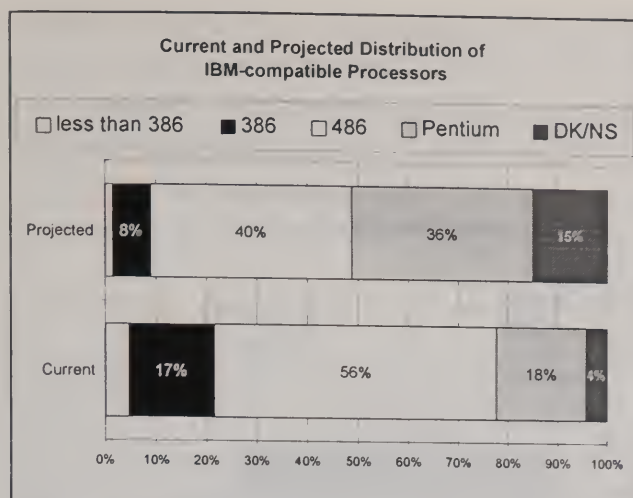
[24] Chi-square=20.9, df=15, p>0.13

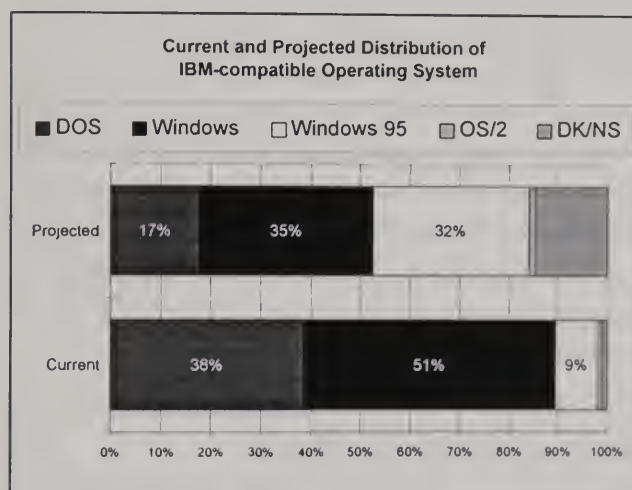**Figure 28. IBM-compatible Processor Upgrades**

Figure 29. IBM-compatible Operating System Upgrades
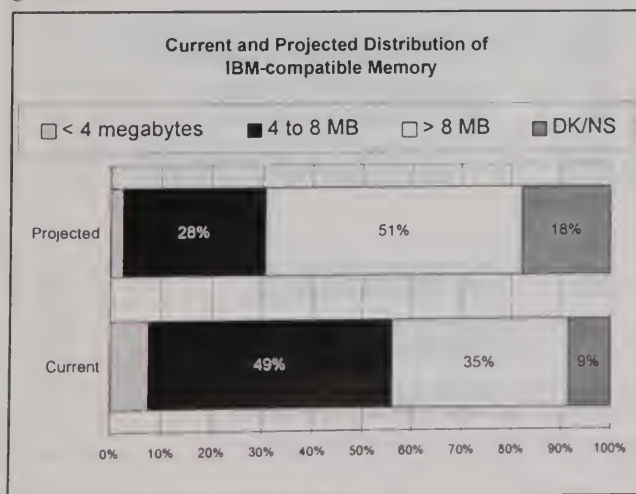

Figure 30. IBM-compatible Memory Upgrades

There is some uncertainty about upgrades in computer equipment over the next 12 months, since respondents are asked to predict future actions. The general picture that emerges is one of upgrading to higher-end equipment. As shown in Figure 28, after upgrades, less than ten percent of IBM-compatible processors are expected to be a 386 or less. A decrease in the number of 486 processors in use will be balanced out by a large increase in the number of Pentiums.

Over the coming twelve months, IBM-compatible users expect to make significant upgrades to their operating systems. Figure 29 combines the data on current operating systems with the twelve month projections. Those answering both questions will not be the same set of respondents answering just the present status question alone. The results suggest that there will be a migration away from DOS only usage to a greater reliance on Windows. About 32 percent of users indicate intentions to upgrade to Windows 95. About 35 percent will be using Windows 3.x either by not upgrading or upgrading from DOS only usage. About 17 percent will be using DOS (but may have Windows available), which is down from the present 38 percent. About one percent will be using OS/2.

With respect to computer memory, the results suggest that there is a strong intention to obtain more (see Figure 30). Over half of the IBM-compatible users suggest that they expect to have eight megabytes or more of memory. This would go hand in hand with the large proportion of users intending to upgrade their processors and operating systems to Pentiums and Windows 95.

Macintosh Equipment Upgrade Profiles

Eighteen percent of computers used for online searching are Macintosh personal computers.

Current and Projected Distribution of Macintosh Memory

Under 4 MB — 1%, 2%
4 to 8 MB — 22%, 36%
More than 8 MB — 69%, 57%
DK/NS — 9%, 5%

Current and Projected Distribution of Macintosh Operating System

DK/NS — 15%, 5%
System 7 — 82%, 89%
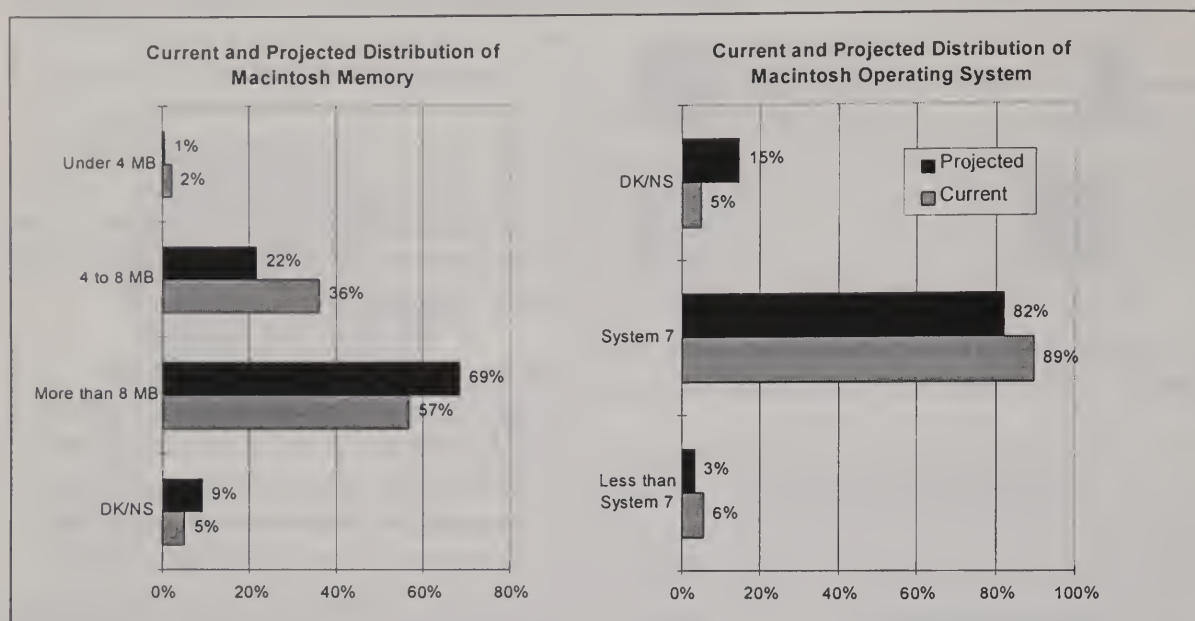Less than System 7 — 3%, 6%

Projected / Current

Figure 31. Macintosh Memory and OS Upgrades

Based on memory and operating systems described by respondents, there will not be the major amount of upgrades expected with the IBM and compatible personal computers. There will be some improvement in memory and some migration into the system 7 operating system.

IBM v. Mac Comparisons

Ninety-two percent of respondents use a modem to access NLM databases. With respect to modem speed, currently Macintosh users tend to have faster modems than IBM-compatible users, particularly the 28,800 baud speed. The projected modem speeds are uncertain, but the trend appears to be away from 1,200 and 2,400 baud and towards the 28,800 baud modems. This assumes that those who are unsure about upgrades will keep what they have now.

Current and Projected Modem Speed

■ Not sure ■ 1.2 □ 2.4 ▨ 9.6 ■ 14.4 □ 28.8

Current
Total — 18%, 15%, 42%, 17%
Macintosh — 17%, 9%, 41%, 28%
IBM-compatible — 18%, 16%, 42%, 15%

Projected
Total — 10%, 12%, 34%, 36%
Macintosh — 9%, 8%, 31%, 45%
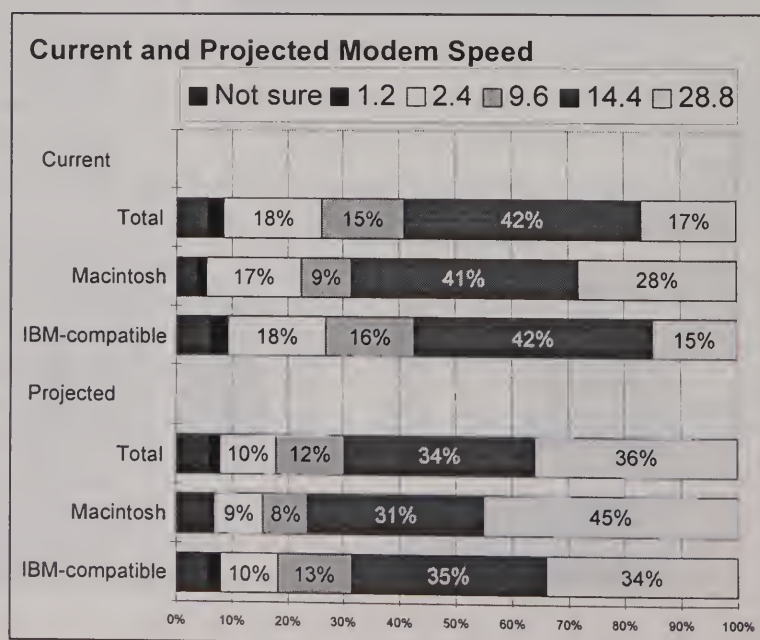IBM-compatible — 10%, 13%, 35%, 34%

Figure 32. Current and Projected Modem Speed

Note: Modem speed is in thousands of baud, or kilobits per second.

Table 15 describes the estimated percentage of users with various levels of computer platforms. Each category is read separately and does not indicate that the user's platform has all the characteristics listed. Of the IBM-compatible users, 52 percent have all the characteristics listed, while 55 percent of the Macintosh users have all the characteristics listed.

Table 15. User Computer Platforms

	IBM-compatible (81% of all respondents)		Macintosh (18% of all respondents)	
		% of IBM Users		% of Mac Users
Processor	486/Pentium	74%		
Memory	4+ MB	84%	4+ MB	93%
Operating System	Windows	87%	System 7	90%
Modem	9,600 baud +	73%	9,600 baud +	77%

Each of these hardware and operating system elements add to the chances that the user will have access to the Internet. Figure 33 indicates that the proportion of IBM-compatible users with Internet access increases markedly as the equipment or operating systems is more up-to-date (refer to Table 7 for the observed significance levels). A logistic regression analysis[25] was performed to test for confounding effects of these multiple features of the computer platforms. Could one variable be the determining factor, e.g. type of processor - 386, 486, Pentium? All these factors were included in the regression model, and it was found that each had a unique contribution to the chances of a user having Internet access.
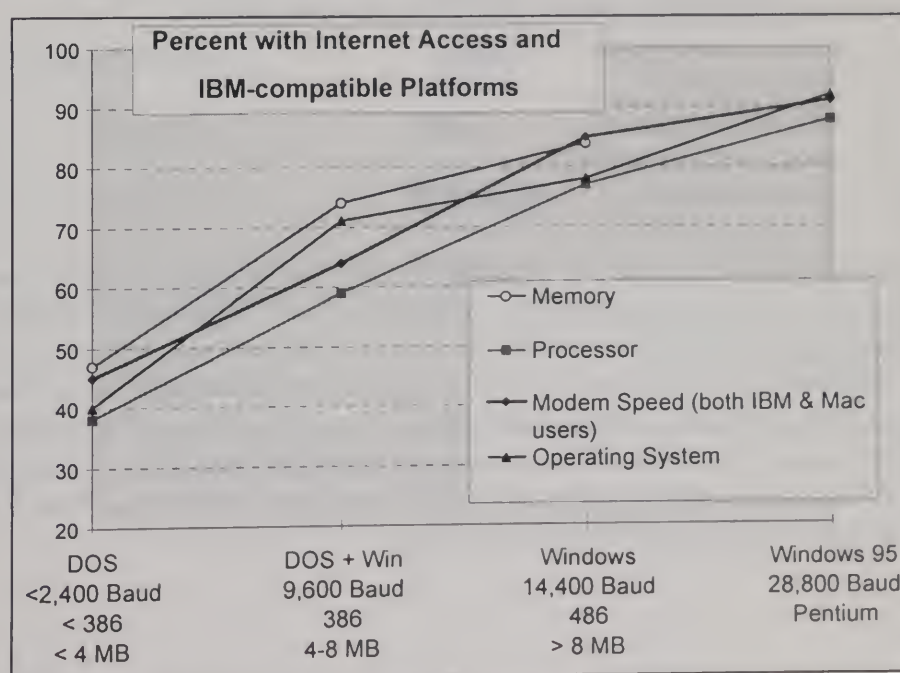

Figure 33. Internet Access and IBM-compatible Computer Platforms

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[25] Refer to Appendix A

NLM CUSTOMER SATISFACTION

Respondents were asked, "So far, are you satisfied with the online services NLM offers?" They were asked to rate their satisfaction on a four point scale ranging from "Very satisfied" to "Very dissatisfied." Respondents are for the most part satisfied with NLM services, since 91 percent reported being either moderately or very satisfied. Four percent are dissatisfied to some degree, with only one percent very dissatisfied. This is a remarkably positive outcome for a customer satisfaction question.

Since there are so few dissatisfied customers, there are insufficient data to separate the four percent into a group to compare to those who are satisfied with the NLM services. Instead, satisfaction was treated as a continuous variable and statistically investigated to ascertain the factors associated with satisfaction. This was accomplished by using a one to four scale as follows:

Figure 34. Satisfaction with NLM Online Services

1. Very satisfied
2. Moderately satisfied
3. Moderately dissatisfied
4. Very dissatisfied

A statistical technique known as analysis of variance (ANOVA - see Appendix A) was used to determine factors associated with satisfaction. A large number of independent variables were examined to determine the statistically significant factors associated with satisfaction. At NLM request, even variables that did not rise to a level of significant difference across membership in the categories of these variables were further analyzed. These are discussed in forms of charts and tables which indicate that levels of satisfaction are quite high regardless of the variable considered. And in those few instances where statistically significant differences were found, the levels of satisfaction nevertheless were still quite high.

Figure 35 illustrates satisfaction with NLM online services as a function of NLM defined geographical regions. The ANOVA indicates that region of the country was not a statistically significant[26] factor in satisfaction with NLM online services. The graph is represented using error bars with a 95% confidence interval.[27] The wider confidence intervals are all due to small sample sizes of the particular region.

Looking at the graph one can see that the confidence intervals for the most part "overlap" in their ranges of values. While Mid Atlantic and South Central regions differ the most in their apparent levels of satisfaction, the confidence intervals for the two regions share common values. The apparent difference is explained by the variation that results in random sampling from a population.
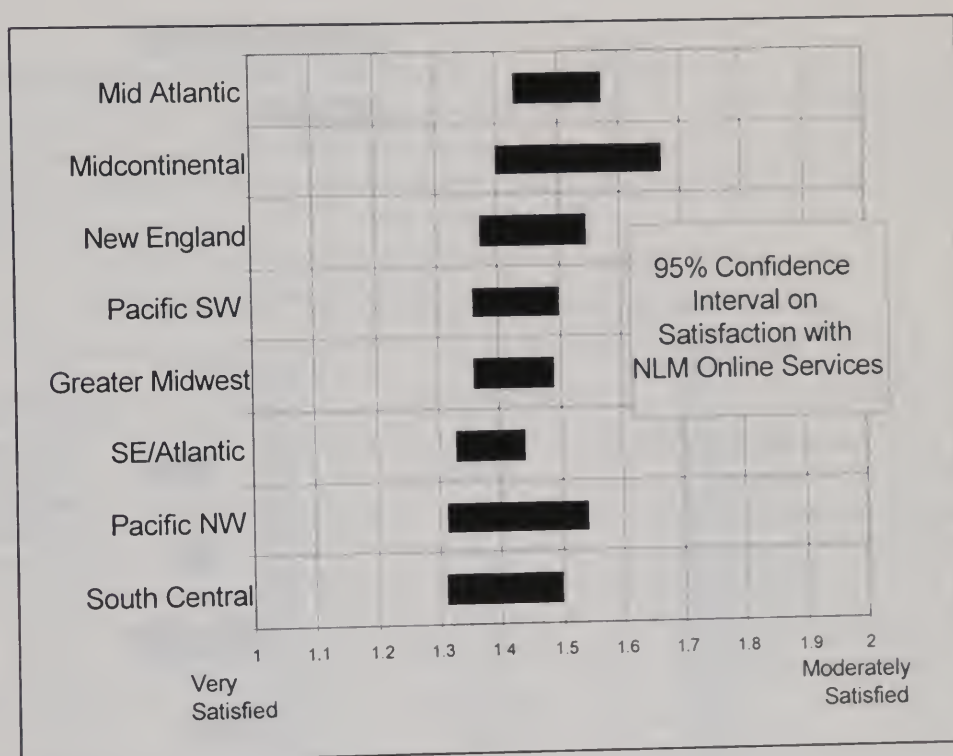

Figure 35. Satisfaction across NLM Regions

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[26] Refer to Appendix A
[27] $F_{(7,1808)}=1.44$, $p>0.18$

Figure 36 indicates the non-significant differences[28] across user groups. Average levels of satisfaction are nevertheless quite high across all groups and are essentially the same with in the precision of measurement.

Figure 36. Satisfaction by User Group
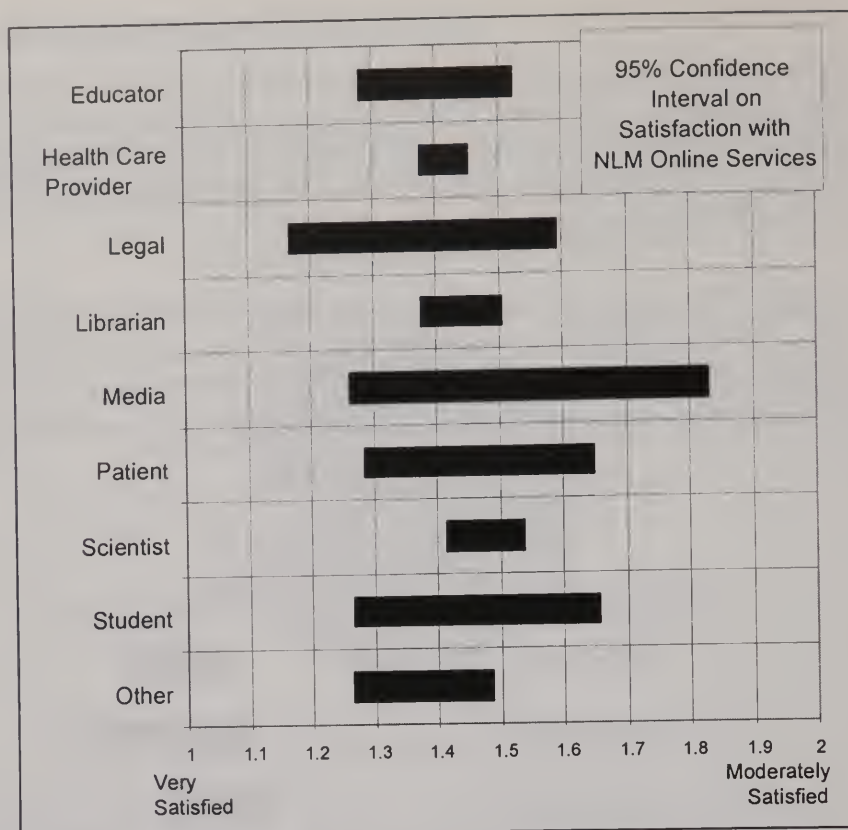
As described previously, using the ZIP codes provided by respondents, it is possible to deduce the type of Census Bureau Metropolitan Statistical Area (MSA Type) the respondent is from. There are no statistically significant[29] differences in satisfaction based on MSA Type.
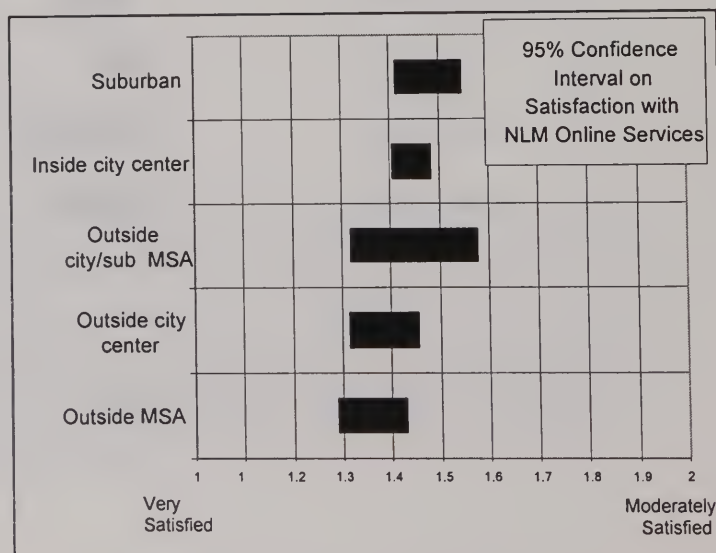

Figure 37. Satisfaction across MSA Types

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[28] $F(9,1850)=0.90$, $p>0.52$
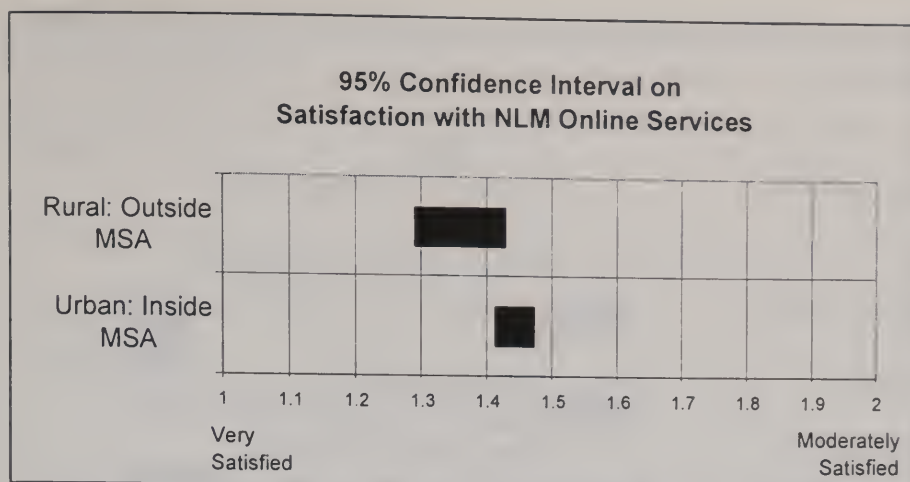[29] $F(5,1854)=1.67$, $p>0.13$

Figure 38. Satisfaction across Urban v Rural types

Refining the MSA Types into Rural versus Urban (Figure 38) in order to detect differences in satisfaction still does not yield statistically significant differences in satisfaction.[30] Here rural is defined as those areas outside the Census Bureau's MSAs.

An ANOVA test was used to determine whether the respondent's state can predict satisfaction levels. Again there are no statistically significant differences.[31] Table 16 suggests an apparently large range of the state average satisfaction levels. However, the small state samples makes for large errors of estimation that require even larger differences in satisfaction than exist here before a difference may be considered statistically significant.

Table 16. States and Territories with Two or More Respondents & Satisfaction Rating

State	Avg. Satisfaction	Count	State	Avg. Satisfaction	Count	State	Avg. Satisfaction	Count
HI	1.82	11	IL	1.46	69	TN	1.36	25
DE	1.80	10	NJ	1.46	67	NC	1.35	37
ID	1.80	10	WV	1.46	13	IN	1.33	21
UT	1.70	10	AL	1.46	24	MS	1.33	12
ME	1.69	13	VA	1.45	58	NM	1.33	18
NE	1.69	13	MA	1.45	76	KY	1.31	16
VT	1.67	9	AZ	1.44	36	IA	1.30	23
CO	1.62	29	TX	1.44	77	WA	1.30	54
DC	1.61	33	KS	1.44	16	FL	1.27	64
OR	1.58	24	MI	1.43	60	MT	1.26	19
NH	1.56	9	MO	1.42	33	GA	1.24	33
NY	1.52	145	MD	1.42	105	ND	1.22	9
OH	1.51	47	CA	1.42	227	PR	1.20	5
SD	1.50	4	CT	1.41	49	OK	1.17	18
MN	1.48	29	AR	1.40	5	NV	1.13	8
LA	1.48	40	SC	1.40	15	RI	1.13	8
PA	1.47	75	WI	1.39	38	WY	1.00	2
			AK	1.38	8			

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[30] $F_{(1,1765)} = 1.35$, $p > 0.05$

[31] $F_{(52,1807)} = 1.20$, $p > 0.15$

The following variables were examined as possible predictors of satisfaction, and all were found not to be statistically significant:

- How often do you search the NLM databases?
- Primary search location
- How do you most frequently search the NLM databases?
- Computer support personnel?
- User group description
- Type of computer most often used
- Memory upgrade -IBM-compatible
- Processor upgrade -IBM-compatible
- Operating system upgrade - IBM-compatible
- Amount of memory - Macintosh

- Macintosh operating system
- Memory upgrade -Macintosh
- Operating system upgrade - Macintosh
- Predicted upgrades
- Use modem to search MEDLINE?
- Highest speed of modem
- Modem speed upgrade
- Access to the Internet
- Use Internet to access NLM databases?
- Projected access to the Internet

Several variables were found that predict variation in satisfaction. These variables involve the quality of IBM-compatible computer equipment that the users have available for online searches. In order to examine these relationships more closely a variable was created to describe low-end and high-end users:

> **low-end users (n=33)**
> > DOS only, *and*
> > less than 4 MB memory, *and*
> > less than a 386

> **high-end users (n=91)**
> > Windows 95 or OS/2, *and*
> > more than 8 MB memory, *and*
> > a 486 or Pentium

A medium range user (n=1,356) is defined as one who is *not* in either of these two categories. Significant differences were found across these three groups - low, medium and high-end users.[32] More specifically, differences in satisfaction were found based on the kind of IBM-compatible processor[33] and operating system[34] in the user's equipment platform. It should be emphasized that the levels of satisfaction among users with all types of equipment are quite high. However, the pattern is one of decreasing satisfaction with higher-end IBM-compatible users as shown in Figure 39. A similar pattern was not found for Macintosh users. This may reflect other factors not measured by this survey. None of these results point directly to a causal relationship determining satisfaction. For example, if the NLM databases are moved into configurations re-

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[32] $F(2,1477)= 5.69$ $p<.004$
[33] $F(4,1462)3.79$ $p<.005$
[34] $F(5,1454)=4.10$ $p<.001$

quiring more high-end environments. it is not clear this will "cause" a decline in overall satisfaction. Such a prediction would go beyond the data at hand. This may be a case where statistically significant differences have no practical significance, since the overall levels of satisfaction are so high.
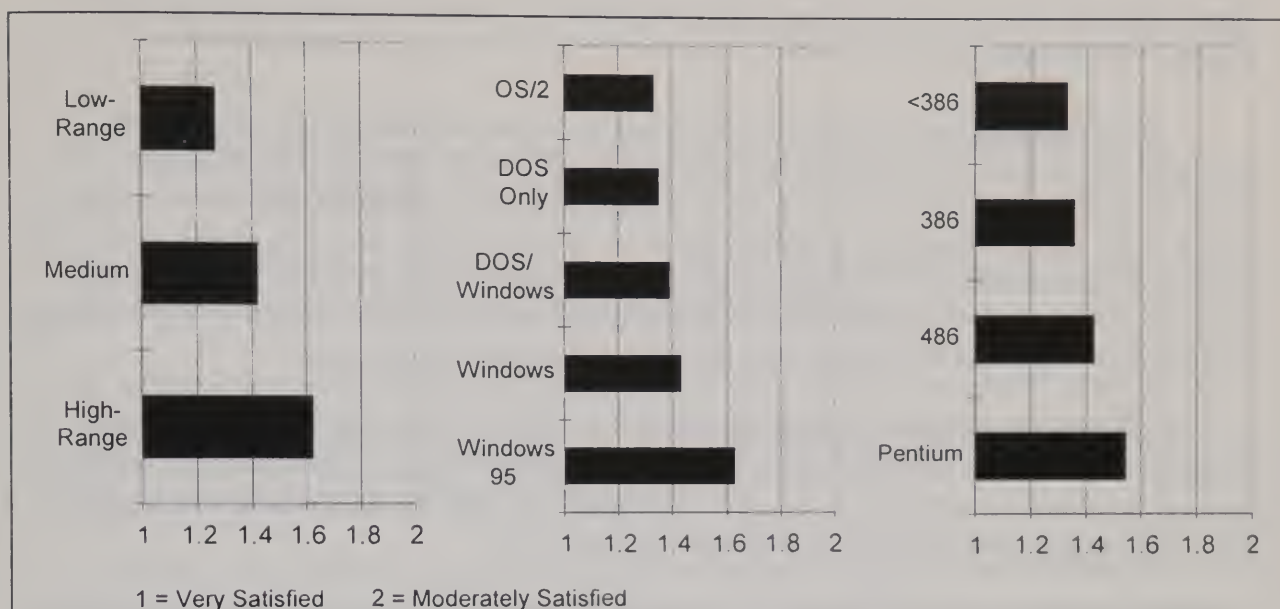

Figure 39. Significant Differences in Satisfaction

CONCLUSIONS

The survey process. The 83 percent final response rate as a percent of eligible respondents is exceptionally high for a mail-out survey. No statistically significant differences in response rates were found across states, Metropolitan Statistical Area (MSA) types, or NLM regions. The high overall response rate combined with these statistical results indicate that nonresponse bias is unlikely.

NLM customer base. Health care providers, librarians (including other information services professionals), and scientists account, collectively, for 85 percent of NLM database users responding to the survey. The majority of users search NLM databases three or fewer times a month. As a group, librarians and information services professionals search most frequently; 58 percent report searching NLM databases more than ten times per month. Scientists as a group are the second most frequent searchers; 45 percent report searching four or more times per month (compared to 77 percent of librarians and information services professionals).

The office and the home are the most frequent locations for conducting NLM database searches. The office is the primary search location for about 47 percent of respondents, and the home is the primary location for 32 percent. The pattern reverses for the secondary search location. The primary search locations for major user groups are:

- health care providers--49 percent from home, 40 percent from the office; 8 percent from a hospital, and 3 percent from a library.
- scientists--79 percent from the office, 18 percent from home.
- librarians--56 percent from a library, 25 percent from the office, 12 percent from a hospital, and 7 percent from home.

The "librarian in a library" is the largest single user-location grouping among the most frequent searchers of NLM databases. Librarians also make far greater use of the NLM command language (69 percent compared to 22 percent for all respondents), and less use of Grateful Med (30 percent compared to 76 percent for all respondents).

About 12 percent of respondents conduct searches from outside MSAs, and are thus defined as rural users. Survey results indicate no statistical difference between rural and urban users with respect to frequency of use. Nor is there any statistical difference across NLM regions regarding frequency of use.

Internet access and use. Overall, about 25 percent of respondents do not currently have Internet access and 75 percent do have access. Percentages of Internet access were compared for a wide range of variables. The results indicate that at present:

- Scientists as a group are more likely to have Internet access than librarians or health care providers, but not significantly more likely than educators.

- Those who use hospitals as primary search locations are less likely to have Internet access.

- Users who search from outside an MSA or in rural areas are less likely to have Internet access.

- IBM-compatible computer users are less likely than Macintosh users to have Internet access.

- Users with the more up-to-date equipment and operating systems are more likely to have Internet access.

Internet access does not appear to vary as a function of search frequency, NLM region, or availability of computer support personnel for IBM-compatible users.

Overall, about 36 percent of rural respondents do not have Internet access, compared to 25 percent of all respondents. Compared to other search locations, hospitals and rural libraries have the lowest Internet access, with 51 percent of rural hospitals (48 percent of all hospitals) and 49 percent of rural libraries currently lacking access.

Survey results indicate that, as users upgrade computer equipment over the next 12 months, hospitals are likely to continue to be disadvantaged regarding Internet access. Internet access is likely to be disproportionately higher for users with the most up-to-date computer hardware and operating systems, including IBM-compatible users with access to Windows, 486 or Pentium processors, and more than 4 Megabytes of memory, and all users with the highest speed modems.

Taken together, these results suggest the need for continuing special outreach efforts directed at rural and hospital-based users, rural libraries, and other users with limited Internet access or computer platforms. The results also reinforce the need for monitoring of user upgrades that would narrow gaps in Internet access.

The majority (58 percent) of those without current Internet access indicated an intent to upgrade to Internet within 12 months. If these upgrades occur, the percentage of respondents without Internet access could decrease to as low as 11 percent. In the worst case, assuming all "don't know/not sure" respondents do not upgrade, the percentage without Internet access would be 19 percent. Estimating within a 95 percent confidence level, at best 8.5 to 12.9 percent and at worst 17 to 21.4 percent of NLM online users will not have Internet access in twelve months.

Most of the users with Internet are not currently using Internet to access NLM databases. Of the 75 percent of respondents with Internet, one-quarter are using Internet to access NLM databases. However, about three-quarters are using Internet to access the World Wide Web and 85 percent use Internet for electronic mail. This highlights the considerable potential for use of Internet to access NLM, as NLM databases become more visible and accessible via the Internet.

Combined with the already high percentage of NLM users with Internet access, and the likelihood of further upgrades to Internet, the survey results provide a strong basis for NLM's transition to Internet-based delivery options, such as Internet Grateful Med and NLM World Wide Web sites.

<u>Equipment profile</u>. Overall, 81 percent of respondents use IBM-compatible personal computers, and 18 percent use Macintosh computers.

For IBM-compatible users, all but about 13 percent have some version of the Windows operating system available on their computers, although another 27 percent have Windows but use DOS. With upgrades, in 12 months the percentage of IBM-compatible users without Windows could fall to about 4 percent. In other words, the Windows operating system will be almost universal among IBM-compatible users. This suggests the possibility of using Grateful Med for Windows as an interim solution for IBM-compatible customers still without Internet access.

Projected upgrades in computer equipment over the next 12 months are inherently uncertain, given that respondents are asked to predict future actions. The general picture that emerges is one of upgrading to higher-end equipment. After upgrades, only about nine percent of IBM-compatible processors are expected to be 386 or less. The proportion of IBM-compatible computers with Pentium processors is projected to double to 36 percent. The proportion with more than eight megabytes of memory is expected to increase from 35 to 51 percent. And the proportion with modem speeds of 14.4 kilobaud or faster is projected to increase from 57 to 69 percent, with more than doubling of the 28.8 kilobaud modems (from 15 to 34 percent).

Projected upgrades in Macintosh computers are less dramatic, since about 90 percent of Macintosh platforms already have a System 7 operating system and more than four megabytes of memory. The proportion with more than eight megabytes of memory is expected to increase from 57 to 69 percent, and with modem speeds of 14.4 kilobaud or faster from 67 to 76 percent (with a 50 percent increase in 28.8 kilobaud modems--from 28 to 45 percent). Macintosh users tend to have faster modems.

<u>NLM customer satisfaction</u>. Respondents are for the most part satisfied with NLM online database services, since 91 percent reported being either moderately or very satisfied. Four percent are dissatisfied to some degree, with only one percent very dissatisfied. The levels of satisfaction do not vary significantly across user groups, locations, NLM regions, or levels of current or projected Internet access, among other variables. Users with high-end computer platforms (e.g., Windows 95, more than 8 megabytes of memory, 486 or Pentium processor) are somewhat less satisfied, but still have high levels of satisfaction (roughly midway between moderately and very satisfied).

Acknowledgments

Appendix A

Statistical Glossary

This appendix provides a few brief definitions of standard statistical procedures. For a more detailed discussion of these concepts, the reader is referred to McClave, J.T., Dietrich II, F.H., *Statistics 3rd Ed.* 1985, Dellen Publishing, Riverside NJ.

Adjusted standardized residual
The residual for a cell divided by an estimate of its standard deviation.

Analysis of variance (ANOVA)
A procedure that divides the total variation in the dependent variable into components (effects) and produces tests for the statistical significance of each component. This statistical technique allows the use of a dependent variable assumed to be measured with error, such as satisfaction in this case being limited to four values. The independent variables are typically categorical. There are two ways ANOVA may be accomplished, including so-called "parametric" and "non-parametric" techniques. The parametric techniques generally have greater statistical power, but the non-parametric ANOVA (Kruskal-Wallis H) can be used to verify any result.

Chi-square (crosstabs, contingency table)
Statistic used to test the hypothesis that the row and column variables are independent. Should not be used if any cell has an expected value less than 1, or if more than 20% of the cells have expected values less than 5.

Confidence interval for a population parameter - 95%
A range of values that 95% of the time includes the (true) population value of the parameter.

Frequency
The count or number of cases having each value (or range of values) of a variable.

Goodness-Of-Fit
A measure of how well the models fits the data. It is based on the squared differences between the observed and predicted probabilities. A small observed significance level for the goodness-of-fit statistic indicates that the model does not fit well.

Kruskal-Wallis 1-way ANOVA
Tests whether k independent samples are from the same population. Nonparametric equivalent of one-way ANOVA.

Likelihood ratio chi-square
A goodness of fit statistic similar to Pearson's chi-square. For large sample sizes, the two statistics are equivalent. The advantage of the likelihood-ratio chi-square is that it can be subdivided into interpretable parts that add up to the total.

Logistic regression
The probability of a dichotomous outcome variable is predicted from a set of independent variables. The model is:
$Pr(event)=1/(1+exp(-(B0 + B1*X1 + B2*X2 +...+ Bk*Xk)))$

Observed significance level
The basis for deciding whether or not to reject the null hypothesis. It is the probability that a statistical result as extreme as the one observed would occur if the null hypothesis were true. If the observed significance level is small enough, usually less than 0.05 or 0.01, the null hypothesis is rejected.

Nonparametric Statistical Tests

Methods for comparing two or more populations that are based on an ordering of the sample measurements according to their relative magnitudes. These techniques require fewer or less stringent assumptions concerning the natures of the populations whence the samples were drawn than do the statistically more powerful parametric tests.

Pearson chi-square

The Pearson chi-square statistic is one of the ways to measure how well the selected model fits the data. It is the sum of squares of residuals, individually weighted by the reciprocal of their expected counts. When its significance level is small, it implies that the expected counts are too far from the observed counts, even adjusted for their size. For a saturated model, the Pearson chi-square statistic is zero.

Standardized residual

The standardized residual is the residual divided by the standard error of the observed count. Under the Poisson assumption, the sum of squares of standardized residuals is the Pearson chi-square statistic, hence standardized residuals are also known as Pearson residuals. They can therefore be used to check the individual contribution to the Pearson Chi-squares. Standardized residuals are asymptotically normal, with zero mean and a variance less than one.

Statistical significance

refers to apparent differences or relationships that are found that have small probabilities of chance occurrence. Typically, for single statistical test of probability, "small" has a rule of thumb value of 5 percent, but may be more or less depending on what is involved in the case of a wrong decision. In *ex post facto* research that five percent value is divided by the number of tests involved in order to reduce the number of spurious "findings." For example, if 100 tests for significance are carried out, the "small" probability becomes 0.05/100 or 0.0005.

Standard error

A measure of how much the value of a test statistic may vary from sample to sample. It is the standard deviation of the sampling distribution for a statistic. For example, the standard error of the mean is the standard deviation of the sample means.

Wald (logistic regression)

A statistic which tests the null hypothesis that a coefficient in a logistic regression model is zero. It has the undesirable property that when the absolute value of the regression coefficient is large, the estimated standard error is too large and the Wald statistic is too small. Whenever you have a large coefficient, do not rely on the Wald statistic for hypothesis testing. Instead look at the improvement in chi-square when the variable is added to the model.

Appendix B

Survey Cover Letter

October 30, 1995

Dear Colleague:

The National Library of Medicine (NLM) would appreciate your assistance by responding to a brief questionnaire about how you, our customer, currently access our information services. You have been selected as part of a nationally representative sample of our online users.

While we are confident that you will be pleased with improvements we are planning, we need to get your answers to some questions in order to be certain that you can take advantage of the new developments. The survey is one aspect of a continuing effort to improve the quality and availability of NLM's online services based on customer feedback. This survey is authorized under the Government Performance and Results Act (PL 103-62). Your cooperation is entirely voluntary, but it is very important to us.

The questionnaire will take about five to ten minutes to complete. Your answers will not be maintained with any personally identifying information and will be reported only in aggregate form. In addition to answering the questionnaire, we welcome any suggestions you have for improving NLM's products, services, and delivery systems.

Please fill out and return your questionnaire within one week using the enclosed business reply envelope. If you need additional information, please call (800) 639-2030 between 9:00 am and 9:00 pm eastern time.

Thank you for your help.

Yours truly,

Donald A.B. Lindberg, M.D.
Director

Enclosures

Appendix C

Survey Questionnaire

NATIONAL LIBRARY OF MEDICINE
CUSTOMER SURVEY

As part of a continuing effort to improve the quality and availability of its online services, the National Library of Medicine (NLM) would appreciate your taking a few minutes to tell us about the information technologies you currently use and those you anticipate using in the future. As a government agency, we would also like for you to tell us how you, our customer, feel you are presently being served.

For each question, circle the one best answer *unless* the instructions specifically ask you to circle all answers that apply. You may wish to confer with a technical person in your organization to answer some questions. If you have any questions about this questionnaire, you may call (800) 639-2030 between 9 a.m. and 9 p.m. eastern time. Thank you!

1. First, have you used MEDLINE and/or other NLM databases at any time in the past 12 months?

   a. Yes
   b. No

   > If you marked "No" to Question 1, stop here and return your questionnaire in the enclosed business reply envelope. If you marked "yes", proceed to Question 2.

2. How often do you search the NLM databases?

   a. Less than once a month
   b. 1-3 times each month
   c. 4-10 times each month
   d. More than 10 times each month

3. From what location(s) do you conduct searches? Rank order by frequency. Use "1" for the most frequent, "2" for the second most frequent, etc.

   ___ Office
   ___ Hospital
   ___ Library
   ___ Home
   ___ Other (specify)_____

4. How do you most frequently search the NLM databases?

   a. Using Grateful Med
   b. Using the NLM command language
   c. Don't know or not sure

5. Do you have computer support personnel and/or a network/system administrator to help with hardware and software installations?

   a. Yes
   b. No
   c. Don't know or not sure

6. Please identify the one user group that best describes you:

   a. Practicing physician, nurse, or other health professional
   b. Scientist
   c. Educator
   d. Student
   e. Librarian or other information services professional
   f. Patient or other health care consumer
   g. Other (specify)_____

7. Please enter the zip code of the location from which you do most of your searching.

   [ ][ ][ ][ ][ ]

8. What one type of **computer** do you *most often use* to search MEDLINE and other NLM databases?

   a. IBM-compatible   ☞ GO TO Q9
   b. Macintosh   ☞ GO TO Q15
   c. Unix   ☞ GO TO Q22
   d. Dumb terminal only; no computer   ☞ GO TO Q19
   e. Don't know or not sure   ☞ GO TO Q22

   ☞ **TURN PAGE OVER**

IBM-COMPATIBLE PC USERS ONLY Q9-14

9. What type of *processor* does this computer have now?

   a. Less than a 386 processor
   b. 386 processor
   c. 486 processor
   d. Pentium
   e. Don't know or not sure

10. How much *memory* does this computer have now?

    a. Under 4 megabytes (MB)
    b. 4 to 8 MB
    c. More than 8 MB
    d. Don't know or not sure

11. What *operating system* do you use on this computer now?

    a. I use Windows, Windows for Workgroups, or Windows NT
    b. I use Windows '95
    c. I use DOS, but the computer can run Windows
    d. I use DOS only, and the computer doesn't have Windows
    e. OS/2
    f. Don't know or not sure

12. Within the next 12 months, to what type of *processor* do you expect this computer or its replacement will be upgraded?

    a. Processor is not likely to be upgraded
    b. Will be upgraded to 386 processor
    c. Will be upgraded to 486 processor
    d. Will be upgraded to Pentium
    e. Don't know or not sure

13. Within the next 12 months, after upgrades, how much *memory* do you expect this computer or its replacement will have?

    a. Memory will not be upgraded
    b. 4 to 8 MB
    c. More than 8 MB
    d. Don't know or not sure

14. Within the next 12 months, to what type of *operating system* do you expect this computer or its replacement will be upgraded?

    a. Operating system will not be upgraded
    b. Windows, Windows for Workgroups, or Windows NT
    c. Windows '95
    d. OS/2
    e. Don't know or not sure

☛GO TO Q21

MACINTOSH USERS ONLY Q15-18

15. How much *memory* does this Macintosh computer have now?

    a. Under 4 megabytes (MB)
    b. 4 to 8 MB
    c. More than 8 MB
    d. Don't know or not sure

16. What *operating system* does this computer have now?

    a. Less than System 7
    b. System 7
    c. Don't know or not sure

17. Within the next 12 months, after upgrades, how much *memory* do you expect this computer or its replacement will have?

    a. Memory will not be upgraded
    b. 4 to 8 MB
    c. More than 8 MB
    d. Don't know or not sure

18. Within the next 12 months, to what type of *operating system* do you expect this computer or its replacement will be upgraded?

    a. Operating system will not be upgraded
    b. System 7
    c. Don't know or not sure

☛GO TO Q21

19. What type of dumb terminal do you use?

    a. Emulates VT-100
    b. Emulates VT-102
    c. Don't know or not sure

20. Within the next 12 months, to what type of computer do you expect this dumb terminal will be upgraded?

    a. Will not be upgraded
    b. Macintosh
    c. IBM-compatible
    d. Other:_____
    e. Don't know or not sure

ALL USERS CAN ANSWER Q21-35

21. How confident are you that your predicted upgrades in type of processor, memory, or operating systems (if any) will actually occur in the next 12 months?

    a. No upgrades expected
    b. Virtually certain
    c. Probable
    d. Possible

22. Please circle any features your computer possesses.
    CIRCLE ALL THAT APPLY.

    a. Has a color monitor
    b. Is a lap top

23. Do you use a modem to search MEDLINE and other NLM databases?

    a. Yes
    b. No   ☞ GO TO Q26
    c. Don't know or not sure ☞ GO TO Q26

24. What is the highest *speed* this modem can use now for data (not FAX) connections?

    a. 1200 baud
    b. 2400 baud
    c. 9600 baud
    d. 14400 baud
    e. 28800 baud
    f. Don't know or not sure

25. Within the next 12 months, to what speed do you expect this modem will be upgraded or replaced?

    a. No upgrades to modem speed are expected
    b. 2400 baud
    c. 9600 baud
    d. 14400 baud
    e. 28800 baud
    f. Don't know or not sure

26. What type of access to the Internet do you have through the computer you most often use to search NLM's databases?
    CIRCLE ALL THAT APPLY.

    a. I don't have Internet access
                         ☞ **GO TO Q31**
    b. Ethernet, Novell or other local area network (LAN)
    c. Dial-up with a modem (e.g. using SLIP or PPP)
    d. Prodigy, America Online, CompuServe, or other gateways
    e. Don't know or not sure
                         ☞ **GO TO Q31**

27. Do you currently use the Internet as a communications link to access NLM's online databases?

    a. Yes
    b. No   Please specify why not:

28. What services can you access on the Internet, *whether or not you are using them now*?
    CIRCLE ALL THAT APPLY.

    a. E-mail
    b. FTP
    c. Telnet
    d. Gopher
    e. World Wide Web
    f. Other: (please specify)_____
    g. Don't know or not sure

29. Through what mechanisms do you have the capability to access the World Wide Web, even if you aren't using this computer capability now? **CIRCLE ALL THAT APPLY.**

    a. No capability to access the World Wide Web

    b. Web browser, such as Mosaic, Netscape, Web Explorer

    c. Dial-up with modem (e.g. using SLIP or PPP)

    d. Prodigy; America Online, CompuServe, or other gateways

    e. Don't know or not sure

30. What services on the Internet have you actually used in the past 12 months at any time? **CIRCLE ALL THAT APPLY.**

    a. E-mail
    b. FTP
    c. Telnet
    d. Gopher
    e. World Wide Web
    f. Other: (please specify)_____
    g. Don't know or not sure

31. Within the next 12 months, what upgrades in Internet access do you expect that the computer you use to search NLM's databases or its replacement will receive? **CIRCLE ALL THAT APPLY.**

    a. No upgrades in Internet access expected   ☞ **GO TO Q33**

    b. Ethernet, Novell or other local area network (LAN)

    c. Dial-up with a modem (e.g. using SLIP or PPP)

    d. Prodigy, America Online, CompuServe, or other gateways

    e. Don't know or not sure ☞ **GO TO Q33**

32. How confident are you that your predicted upgrades in Internet access will actually occur?

    a. Virtually certain
    b. Probable
    c. Possible

33. So far, are you satisfied with the online services NLM offers?

    a. Very satisfied
    b. Moderately satisfied
    c. Moderately dissatisfied
    d. Very dissatisfied
    e. No opinion

34. Please indicate the reasons you use NLM's online services. **CIRCLE ALL THAT APPLY.**

    a. Easy to use
    b. Cost-effective
    c. Convenient
    d. Quality of customer support
    e. Best option available
    f. Other (specify)_____ ...

> **NOTE:** If you regularly search NLM's databases from a **second** location, please photocopy this questionnaire and respond to questions 7 through 32 for the second location using a different color ink. Please return both questionnaires together.

Thank you for completing this survey.
Please use the enclosed business reply envelope to return the survey to
National Library of Medicine Customer Survey,
126 College Street, Suite 2A, Burlington, VT 05401.

Please attach any additional comments or suggestions
you think would be helpful in NLM's continuous efforts
to improve customer service.

Appendix D

Survey Response At A Glance

A. Users

User groups: *Percent of all users responding*

Health care provider	46%
Librarian	20%
Scientist	19%
Educator	4%
Patient /health care consumer	2%
Student	1%
Legal	1%
Media	2%
Other/Missing	5%

Most frequent search location

Office	47%
Hospital	8%
Library	13%
Home	32%
Other	2%

Search frequency

Less than once a month	19%
1-3 times each month	39%
4-10 times each month	23%
More than 10 times each month	19%

Search method

Grateful Med	77%
NLM command language	22%

B. Equipment Platform

Type of computer used most often   *Percent of all users responding*

IBM-compatible	81%
Macintosh	18%

B-1. IBM Compatible Users

Processor   *Percent of IBM-compatible users responding*

Less than a 386	5%
386	17%
486	56%
Pentium	18%

Memory

Under 4 MB	8%
4 to 8 MB	49%
More than 8 MB	35%

B-1. IBM Compatible Users - continued

Operating system

DOS without Windows	11%
Windows -total	87%
DOS with Windows available	27%
Windows	51%
Windows 95	9%

B-2 Macintosh Users

Memory

Under 4 MB	2%
4 to 8 MB	36%
More than 8 MB	57%

Operating System

Less than System 7	6%
System 7	89%

B-3 Modem Use

Modem used to search — *Percent of all users responding*

Yes	92%
No	7%

Modem Speed

1200 Baud	3%
2400 Baud	18%
9600 Baud	15%
14400 Baud	42%
28800 Baud	17%

C. Internet Access and Use

Type of Internet Access

		Percent of all respondents
No access to the Internet		25%
Internet Access		75%
	LAN	22%
	Dial-up Modem	28%
	Prodigy, AOL, CompuServe, etc.	35%

Currently us Internet as communications link with NLM

	Percent with Internet access
No	74%
Yes	26%

Internet services available

E-mail	91%
FTP	62%
Telnet	60%
Gopher	73%
World Wide Web	84%

Internet services used

E-mail	85%
FTP	41%
Telnet	38%
Gopher	52%
World Wide Web	77%

D. User Satisfaction

Satisfaction with online services NLM offers

	Percent of all users responding
Very satisfied	58%
Moderately satisfied	33%
Moderately dissatisfied	3%
Very dissatisfied	1%
No opinion	5%

Appendix E

Geographic Areas Served by the Regional Medical Libraries

Following is a list of the Regional Medical Libraries and the areas served by each.

1. Middle Atlantic Region
The New York Academy of Medicine
1216 Fifth Avenue
New York, New York 10029
Phone: 212-876-8763
FAX: 212-534-7042
email: RML1@nyam.org
States served: Delaware, New Jersey,
New York, Pennsylvania
ONLINE CENTER for all Regions

2. Southeastern/Atlantic Region
University of Maryland at Baltimore
Health Sciences Library
111 South Greene Street
Baltimore, Maryland 21201-1583
Phone: 410-706-2855
FAX: 410-706-0099
States served: Alabama, Florida, Georgia,
Maryland, Mississippi, North Carolina, South
Carolina, Tennessee, Virginia, West Virginia,
the District of Columbia, Puerto Rico,
and the U.S. Virgin Islands

3. Greater Midwest Region
University of Illinois at Chicago
Library of the Health Sciences (M/C 763)
1750 West Polk Street
Chicago, Illinois 60612-7223
Phone: 312-996-2464
FAX: 312-996-2226
List-serv: GMR-Info@uic.edu
States served: Iowa, Illinois, Indiana, Kentucky,
Michigan, Minnesota, North Dakota, Ohio,
South Dakota, and Wisconsin

4. Midcontinental Region
University of Nebraska Medical Center
Leon S. McGoogan Library of Medicine
600 South 42nd Street
Omaha, Nebraska 68198-6706
Phone: 402-559-4326
FAX: 402-559-5482
States served: Colorado, Kansas, Missouri,
Nebraska, Utah, and Wyoming

5. South Central Region
Houston Academy of Medicine-
Texas Medical Center Library
1133 M.D. Anderson Boulevard
Houston, Texas 77030
Phone: 713-790-7053
FAX: 713-790-7030
email: #nnlm@library.tmc.edu
States served: Arkansas, Louisiana, New
Mexico, Oklahoma, and Texas

6. Pacific Northwest Region
Health Sciences Library
University of Washington
Box 357155
Seattle, WA 98195-7155
Phone: 206-543-8262
FAX: 206-543-2469
email: nnlm@u.washington.edu
States served: Alaska, Idaho, Montana,
Oregon, and Washington

7. Pacific Southwest Region
University of California at Los Angeles
Louise Darling Biomedical Library
10833 Le Conte Avenue
Los Angeles, California 90024-1798
Phone: 310-825-1200
FAX: 310-825-5389
States served: Arizona, California, Hawaii,
Nevada, and U.S. Territories in the Pacific
Basin

8. New England Region
University of Connecticut Health Center
Lyman Maynard Stowe Library
263 Farmington Avenue
Farmington, Connecticut 06034-4003
Phone: 203-679-4500
FAX: 203-679-1305
States served: Connecticut, Maine,
Massachusetts, New Hampshire,
Rhode Island, and Vermont